JOURNAL OF THE BOSTON SOCIETY OF CIVIL ENGINEERS

MAY, 1925

Featuring

- Supports for Superimposed Stacks
- Construction of the Neponset Bridge
- Airplane Aids U. S. G. S. Mapping

Vol. XII No. 5

BOSTON SOCIETY OF CIVIL ENGINEERS

OFFICERS, 1925-1926

PRESIDENT

RICHARD K. HALE

VICE-PRESIDENTS

FRANK A. MARSTON
(Term expires March, 1926)

CHARLES B. BREED
(Term expires March, 1927)

SECRETARY AND LIBRARIAN

JOHN B. BABCOCK, 3d

TREASURER

FRANK O. WHITNEY

DIRECTORS

CHARLES R. MAIN
(Term expires March, 1926)

FRANK E. WINSOR
(Term expires March, 1926)

HENRY S. ADAMS
(Term expires March, 1927)

GEORGE A. SAMPSON
(Term expires March, 1927)

PAST PRESIDENTS

(Members of the Board)

DUGALD C. JACKSON
FRANK M. GUNBY
EDWIN H. ROGERS

SANITARY SECTION

E. SHERMAN CHASE, Chairman
RALPH W. HORNE, Clerk

DESIGNERS SECTION

J. STUART CRANDALL, Chairman
SCOTT KEITH, Clerk

NORTHEASTERN UNIVERSITY SECTION

SIDNEY S. ANTHONY, Chairman
WILBERT H. CONNOR, Clerk

HIGHWAY SECTION

HENRY A. VARNEY, Chairman
HAROLD F. MacWILLIAMS, Clerk

Editor — JOHN B. BABCOCK, 3d
715 Tremont Temple, Boston

JOURNAL OF THE
BOSTON SOCIETY
OF
CIVIL ENGINEERS

Volume XII MAY, 1925 Number 5

CONTENTS

PAPERS AND DISCUSSIONS

PAGE
Supports for Superimposed Stacks. By Walter W. Clifford . . 221
Construction of the Neponset Bridge. By J. Stuart Crandall 232

OF GENERAL INTEREST

Airplane to Aid in Mapping 244
Forty-foot Channel for Boston Harbor 245
Two New Publications 245
Bond in Footings 246
Library Books for Sale 247
Proceedings of the Society 249

Published Monthly, except July and August, by the Society
715 Tremont Temple, Boston, Massachusetts

Subscription Price, $4.00 a Year (10 Copies)
50 Cents a Copy

Copyright, 1925, by the Boston Society of Civil Engineers.

Entered as second-class matter, January 15, 1914, at the Post Office at Boston, Mass., under Act of August 24, 1912.

Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 16, 1918.

The Society is not responsible for any statement made or opinion expressed in its publications.

BOSTON
WRIGHT & POTTER PRINTING COMPANY
32 DERNE STREET

JOURNAL OF THE

BOSTON SOCIETY OF CIVIL ENGINEERS

Volume XII MAY, 1925 Number 5

SUPPORTS FOR SUPERIMPOSED STACKS

BY WALTER W. CLIFFORD,* MEMBER, BOSTON SOCIETY OF CIVIL ENGINEERS

(Presented before the Designers Section, February 11, 1925)

POWER station stacks were formerly built on the ground adjacent to the boiler house, and the flue extended the whole length of the roof, entering the stack well up from its base. Designing supports for such stacks was simply a foundation problem. In late years, however, it has become increasingly common to center the stack over a group of boilers and support it on structural steel. This saves flue run and often improves the draft, and in general it is safe to say that the section between the roof and the ground can be built at least as cheaply of structural steel as of any stack material.

There are three ways of carrying flues into a superimposed stack. With the base of the stack at roof level the flue may run under the roof and turn up into the bottom of the stack, or each flue uptake may go through the roof in the customary way and the combined flues run into the side of the stack. Sometimes the base of the stack is located far enough below the roof to allow flues under the roof to run into the side of the stack. There are obvious advantages to having the flue within the building, such as the use of hung supports and the saving in covering. The arrangement of the flues, however, is a problem for the mechanical engineer and not within the scope of this paper.

The dead loads to be considered in designing stack supports are the weight of the stack, that of the concrete mat used as a leveller on top of the structural steel, and the weight of the steel frame itself. All these may be readily ascertained with considerable precision.

---

* Of Clifford & Roeblad, Consulting Engineers, Boston.

Copyright, 1925, by the Boston Society of Civil Engineers.
Entered as second-class matter, January 15, 1914, at the Post Office
at Boston, Mass., under Act of August 24, 1912.

Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 16, 1918.

The Society is not responsible for any statement made or opinion expressed in its publications.

BOSTON
WRIGHT & POTTER PRINTING COMPANY
32 DERNE STREET

JOURNAL OF THE
BOSTON SOCIETY OF CIVIL ENGINEERS

Volume XII MAY, 1925 Number 5

SUPPORTS FOR SUPERIMPOSED STACKS

BY WALTER W. CLIFFORD,* MEMBER, BOSTON SOCIETY OF CIVIL ENGINEERS

(Presented before the Designers Section, February 11, 1925)

POWER station stacks were formerly built on the ground adjacent to the boiler house, and the flue extended the whole length of the roof, entering the stack well up from its base. Designing supports for such stacks was simply a foundation problem. In late years, however, it has become increasingly common to center the stack over a group of boilers and support it on structural steel. This saves flue run and often improves the draft, and in general it is safe to say that the section between the roof and the ground can be built at least as cheaply of structural steel as of any stack material.

There are three ways of carrying flues into a superimposed stack. With the base of the stack at roof level the flue may run under the roof and turn up into the bottom of the stack, or each flue uptake may go through the roof in the customary way and the combined flues run into the side of the stack. Sometimes the base of the stack is located far enough below the roof to allow flues under the roof to run into the side of the stack. There are obvious advantages to having the flue within the building, such as the use of hung supports and the saving in covering. The arrangement of the flues, however, is a problem for the mechanical engineer and not within the scope of this paper.

The dead loads to be considered in designing stack supports are the weight of the stack, that of the concrete mat used as a leveller on top of the structural steel, and the weight of the steel frame itself. All these may be readily ascertained with considerable precision.

---

* Of Clifford & Roeblad, Consulting Engineers, Boston.

The live load is the wind, and it is of relatively large importance in this problem since it causes a large proportion of the maximum stresses. The wind load cannot be determined with precision. The intensity of wind pressure is discussed in all textbooks on structural design, but the data are meagre. The pressure used in chimney design usually varies with the height. For ordinary exposures and stacks up to perhaps 250 feet in height, 20 pounds per square foot of projected area of a round stack is a common figure which has stood the test of actual use. Allowing for the reduction on cylindrical surfaces this corresponds to a wind of about 80 miles per hour, which in this part of the country is seldom exceeded.

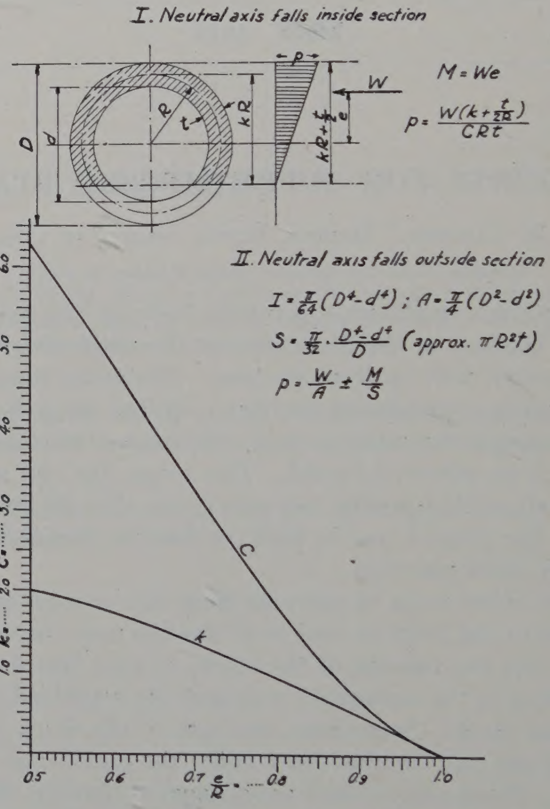

I. Neutral axis falls inside section
p
W
$M = We$
$p = \frac{W(k + \frac{t}{2R})}{CRt}$
D
d
R
t
kR
$kR + \frac{t}{2}$
e
II. Neutral axis falls outside section
$I = \frac{\pi}{64}(D^4 - d^4)$; $A = \frac{\pi}{4}(D^2 - d^2)$
$S = \frac{\pi}{32} \cdot \frac{D^4 - d^4}{D}$ (approx. $\pi R^2 t$)
$p = \frac{W}{A} \pm \frac{M}{S}$
C
k
1.0 k..... 2.0 C..... 3.0
4.0
5.0
6.0
0.5
0.6
0.7 $\frac{e}{R}$ 0.8
0.9
1.0

FIG. 1.—STRESSES IN BRICK CHIMNEYS

The stacks themselves are of concrete, steel or brick. They are frequently designed with the resultant pressure outside of the kern.* Concrete and steel stacks are designed to take tension and are anchored by bolts. Brick stacks, however, cannot be depended on to take tension, and the load distribution on the base of a brick stack, with the resultant outside the kern, can be found only by solving for a segment of an annular ring which with uniformly varying pressure has a centroid of pressure under the resultant of the load. This involves somewhat complicated mathematics, and the diagram, Fig. 1, has been evolved to assist in this case. It is somewhat approximate, as polar co-ordinates and a mean radius are used in computing it, but it is believed to be within the precision to which wind loads can be computed.

The live load under consideration is a moving load, but instead of having a conventional linear motion, it is rotating about a vertical axis. For a problem of any magnitude, it is convenient to make a diagram of the variation of this moving load to the same scale as the framing plans. For the concrete or steel stack it facilitates computations to assume that the entire load from the stack is in the form of concentrations at the bolts. If there are "n" equally spaced bolts around the circumference the dead weight per bolt will be $\frac{W}{n}$, and, since the section modulus of bolts so spaced is $\frac{nr}{2}$, the maximum load due to wind will be $\pm\frac{2M}{rn}$ on the extreme bolts, and a proportionate amount on intermediate bolts. From these loads a diagram such as is shown in Fig. 2 (*a*) can be drawn. With a brick stack a similar diagram can be drawn by arbitrarily dividing the ring into a suitable number of sections of equal area and getting the unit load on each by scaling the distance of its center from the neutral axis, producing a diagram like that shown in Fig. 2 (*b*).

Considering now the framing upon which the stack rests, the loads under a large stack are usually so great that a very heavy mat (3 to 5 feet thick) must be used, or the steel framing will have to follow the ring of the stack base rather closely for the open bottom stack or be

---

* The values of the radius of the kern of an annular ring for various values of t/d, where t is the thickness of the ring and d is the outside diameter, are as follows:

t/d	r (Radius of Kern)
0.0	0.25d
0.1	0.205d
0.2	0.17d
0.3	0.145d
0.4	0.13d
0.5	0.125d

closely spaced for the solid bottom. The steel beam layout for the two cases will usually be about as shown in Fig. 3 (*a*) for the open bottom stack, and as shown in Fig. 3 (*b*) for the solid bottom stack. The beams in Fig. 3 (*a*) should be so located with reference to the base ring of the stack that torsional moment is balanced as far as possible. With wide-spread columns the beams shown dotted may be needed. It is convenient to make the beams shown in Fig. 3 (*b*) of the same depth and to vary the spacing.

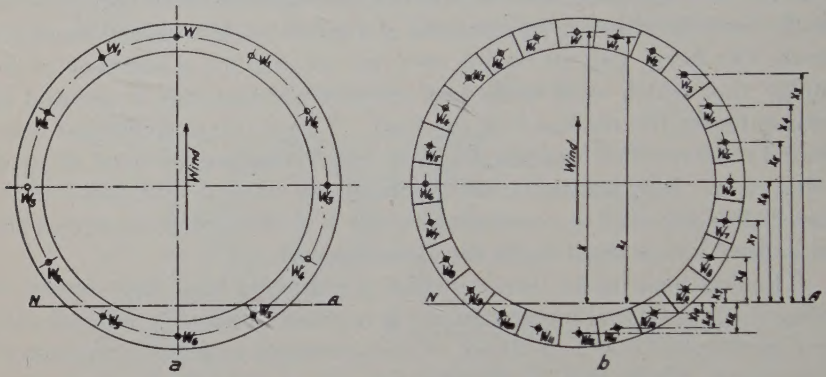


FIG. 2

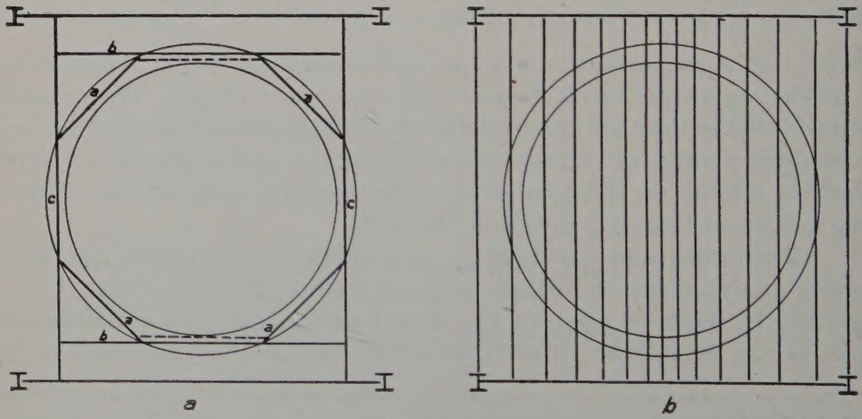


FIG. 3

By superimposing the proper diagram of the type of Fig. 2 over a sketch of the framing as shown in Fig. 3, and rotating it about the axis, the maximum loading for the various beams may be readily ascertained. In Fig. 3 (*a*), for example, the loading for beam "a" (not considering the dotted beams) will be a maximum with the wind normal to the axis of the beam, and will in fact be practically a uniform load of the intensity of the maximum on the center line of the base ring. On beam "b" the maximum moment will be with the wind normal to the beam, and the diagram will facilitate in finding the reaction of beam "a" for this loading. The direction of wind for maximum shear on this beam will very probably be with the wind at an angle with the normal to the beam. In Fig. 3 (*b*) the maximum shear on any of the beams will probably be on the center one with the wind parallel to the axis. The maximum moment will be on one of the outer beams with the wind normal to the beams. Very often in this type of framing the concrete mat will be able to distribute the load, allowing adjacent less-stressed beams to relieve the most-stressed members. The use of a heavy concrete mat in place of the secondary steel framing, as is sometimes done, is purely a question of economy, and the methods of design are similar.

The diagrams of Fig. 3 show one of the most common arrangements of stack in relation to columns. Sometimes the stack is more or less centered on a group of six columns as shown in Fig. 4. In this case, as with any other unusual arrangement of columns in relation to the stack, the direction of the wind for maximum load will be less obvious than in the cases of Fig. 3, but in all of these the diagram of Fig. 2 will be helpful. It should be borne in mind, however, that in some cases dead load alone may give the greatest stress, in certain members.

Before the columns can be designed, the bracing must be located. A logical method of bracing is to combine the bracing for the stack with that of the building proper, using horizontal trusses in the roof to carry the shear of the wind on the chimney to the braced bents. The necessity of leaving a clear head room of about 8 feet above the boiler room floor calls for a portal of this height and corresponding column bending. This portal height should be made as small as possible because of the excessive deflection of a column under bending as compared with a truss, and the resulting vibration due to the intermittent application of wind load. The design of the bracing offers few unusual features. The greatest problem is to find a place to carry bracing down without interfering with mechanical equipment. It is usually more economical to brace a narrow bay, as the saving in weight of the shorter and lighter web members of the narrow bay will usually be greater than the additional weight in the column carried by their larger chord stress. A deeply braced bay is stiffer, however. In a simple boiler house with no economizers the aisle in back of the boilers offers a good chance to brace in planes perpendicular to the firing aisle. It often has the additional advantages of bracing adjacent crane columns in the turbine room. Where this aisle is filled up with heaters or economizers the bracing must be carried down the sides of the boiler settings. Such bracing will be irregular, since it must be carefully laid out to clear all mechanical equipment. Bracing in this

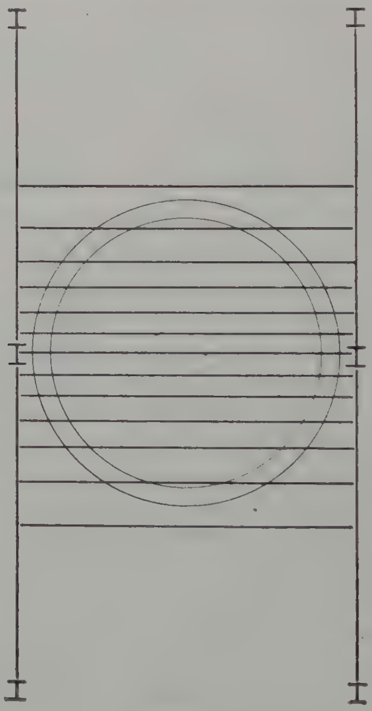


FIG. 4

bay has the advantage that it can be carried to the floor. For the bracing parallel to the firing aisle, the relatively narrow bays between the batteries of boilers are usually the most convenient for bracing. In a large boiler house it is not usually advisable to try to carry the wind loads to the outside walls and use them for bracing, as is common in mill buildings. There are several reasons for this: first, the wind load due to the stack is relatively large; second, trussing it any great distance leads to vibration from the intermittent load which has its effect increased by the swaying chimney; and last, the walls of power stations usually have large window openings and it is not desirable to block them with bracing. Bracing perpendicular to the web of columns is often in two parts, half of it placed in the plane of each flange, the compression members being latticed. Bracing in the other direction is usually in the plane of the web only. An X brace in a horizontal plane at one or two convenient points in the height of the stack bent is an aid to stiffness.

Sometimes, because the building is already built or because of a desire to keep the stack support independent in order to avoid vibration in the building and in the boiler settings, the entire stack load is taken to the ground independently of the steel of the building.

When the vertical stack loads are carried down in a bent of four columns, the direct stress is easily ascertained by P/4A plus M/S, where S is the section modulus of the group of columns and is usually least in a diagonal direction. When more than four columns carry the stack, the intermediate columns tend to introduce a hinge in the mat framing, and the column loads should be computed from the loading diagram, although the stiffness of the girder connections will tend to make the outer columns relieve the most-stressed interior columns of the group to some extent.

The foundations will usually be combined footings, sometimes complicated, but offering no difficulties which are not common to similar footings for other purposes.

There are appended sketches and brief descriptions of four actual stack support designs.

Typical Examples of Stack Supports

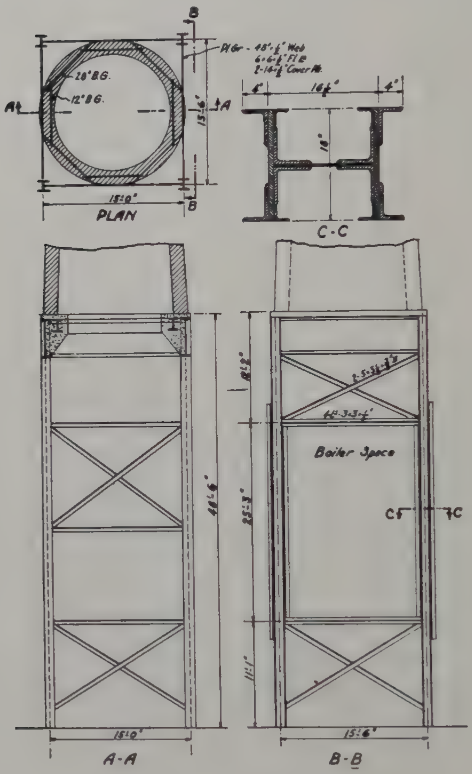


FIG. 5. — EXAMPLE I — STACK SUPPORT

The stack in this case is brick 170 feet high and 15 feet 3 inches outside diameter at the base. The flues are under the roof and turn up into the bottom of the stack.

The owner was afraid vibration might injure the boiler settings so the stack support is independent of the building steel, but as the soil is rather poor the stack support columns rest on a large combined concrete footing which also carries several of the building columns. The steel frame is of simple design, its unusual feature being the heavy column sections. It was necessary to set the support astride a single boiler which required a portal nearly 25 feet high, and the column sections were reinforced as shown to cut down the deflection and reduce the consequent vibration. Jackson & Moreland were engineers on this job which was erected in 1923.

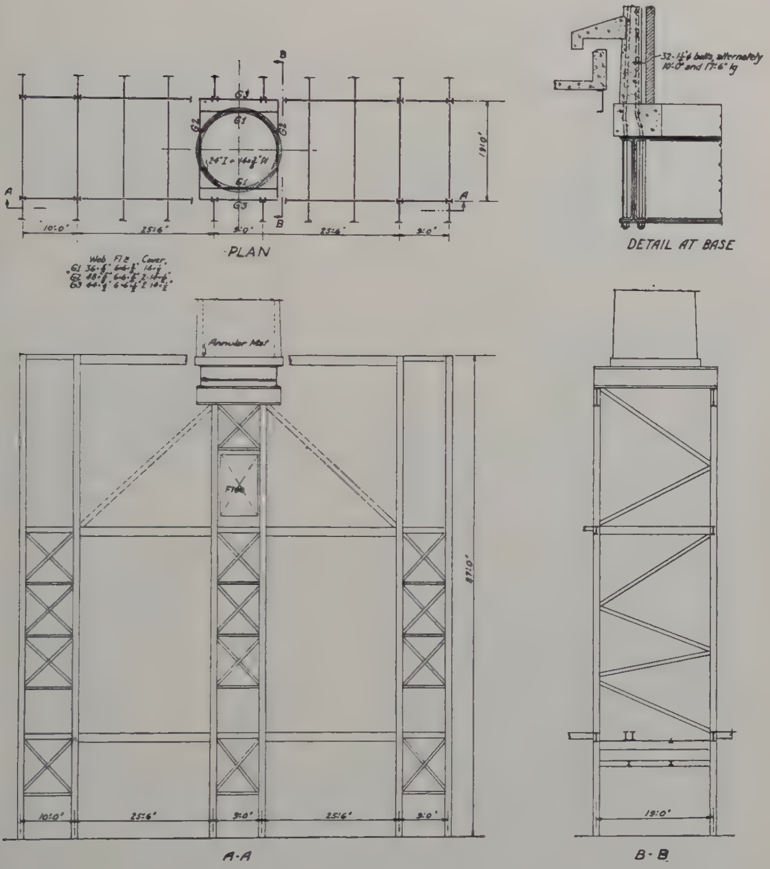


FIG. 6. — EXAMPLE II — STACK SUPPORT

This stack is of concrete 16 feet by 163 feet, and is supported directly on the buildng steel, the flues entering at the bottom. The bracing parallel to the firing aisle is in he narrow bays between the batteries of boilers and the transverse bracing is carried lown the sides of the boilers. An opening between the stack and the edge of the roof vas left for ventilation. Two stacks as shown were erected in 1918. It was found that here was considerable vibration in the columns during a high wind, and so when anther stack was added in 1922 the braces shown dotted were added and materially tiffened the frame. Harry M. Hope Engineering Company were engineers for this vork.

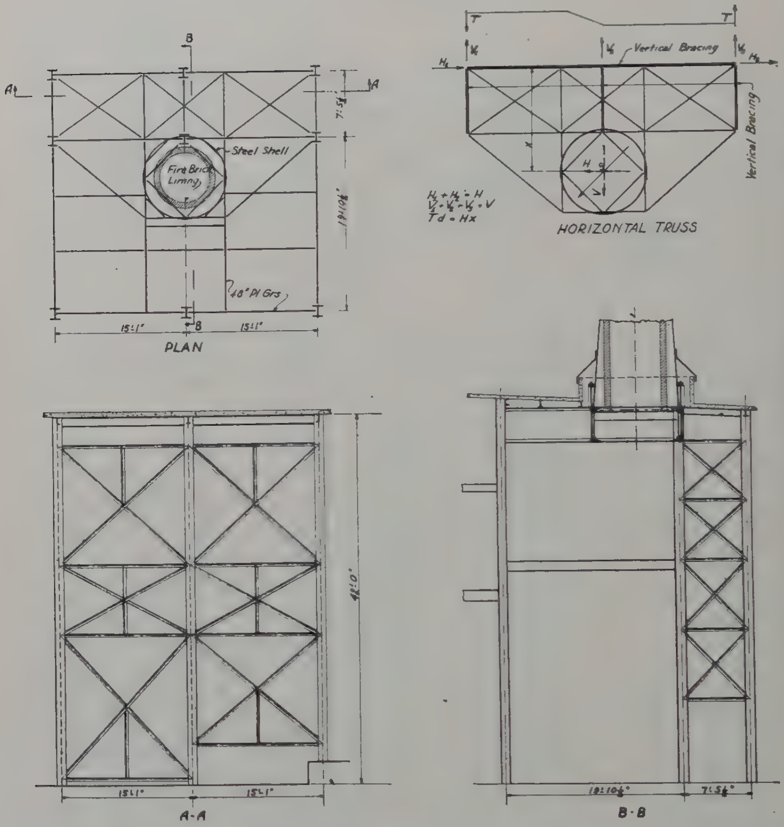


FIG. 7. — EXAMPLE III — STACK SUPPORT

This stack is of steel, 6 feet 6 inches diameter and 133 feet high, supported on th building frame with the flue entering at the bottom.

The interesting feature of this design is the method of bracing. The longitudina bracing is all in one plane in back of the boilers. The moment due to the eccentri location of the stack in relation to this bracing is taken up by the shallow braced bay in the other direction as indicated in the truss diagram. A horizontal truss in the plan of the roof distributes the load. This was built several years ago and has proved a ver rigid frame. Harry M. Hope Engineering Company were engineers.

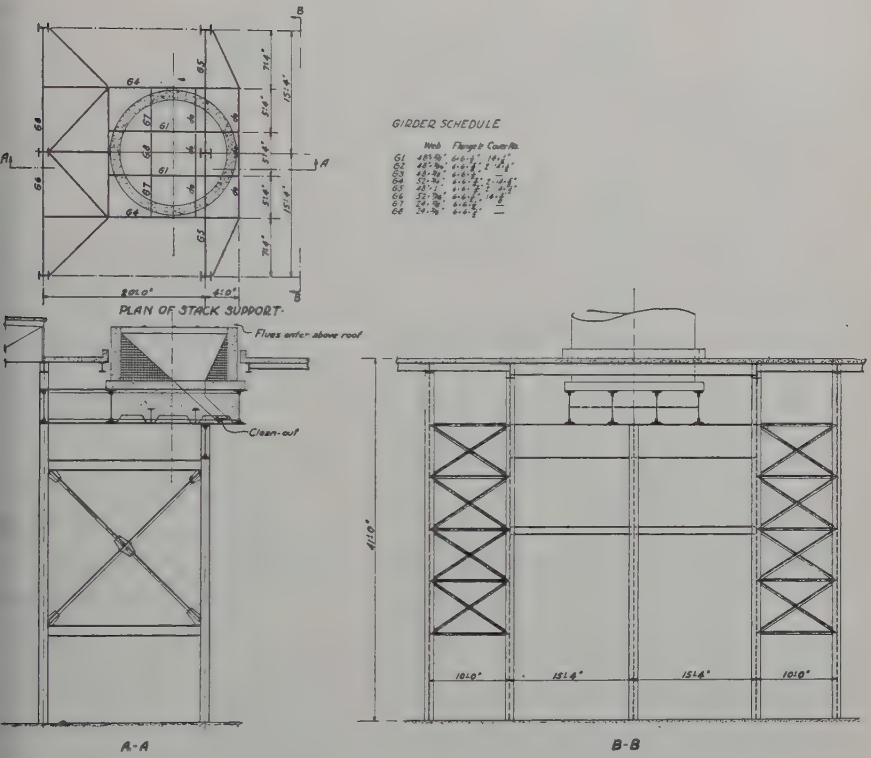


FIG. 8. — EXAMPLE IV — STACK SUPPORT

Unusual Layout of Columns

This stack-support frame is an example of what may occur in the matter of unsymmetrical spacing of columns with relation to the stack. The design is as conventional as it can be under the conditions. This frame has just been designed and has not yet been erected.

CONSTRUCTION OF THE NEPONSET BRIDGE

By J. Stuart Crandall,* Member, Boston Society of Civil Engineers

(Presented before the Designers Section, February 11, 1925)

In 1917, the old Neponset Bridge, so called, having reached the limit of its usefulness, a temporary bridge was built alongside and the old structure removed preparatory to the construction of a new reinforced concrete bridge. This temporary bridge, a wooden structure supported on piling, remained in use far beyond the contemplated period because in those days of rapidly mounting costs the bids kept wel ahead of the appropriations, and it was not until 1922 that the contract for the new bridge was actually let. Several different designs were use in the earlier bidding.

The new bridge, being a part of the proposed Old Colony Parkway system, came under the jurisdiction of the Metropolitan District Commission. The designs of the bridge were prepared under the directio of John R. Rablin, Chief Engineer of the Parks Division of the Commission, in conformity with a general layout by Haven & Hopkins Consulting Architects.

The structure is 791 feet long, consisting of six reinforced concrete arch spans of lengths ranging from 70 to 85 feet, with a Sherzer Rolling Lift Draw Span of 80 feet at the Boston side of the central span. The overall width of 70 feet includes 6-foot sidewalks and a 56-foot roadway having two tracks down the center for electric cars.

As originally designed all the piers and the abutments were to rest on wooden piling. After the signing of the contract it was decided t carry the channel piers deeper to firm bottom and eliminate the piling On the other piers and abutments it was decided to use a concrete mat over the pile heads instead of timber platforms. The piers and abutments are of mass concrete with a facing of coursed-granite rubble between high and low water marks to protect the concrete from the actio of sea water. The arches are circular, of reinforced concrete with hollow spandrels at the haunches and filled over the crown. Concrete place under water is of 1:2:4 proportions, piers and abutments up to the superstructure line of 1:3:6, and the superstructure of 1:2:4.

---

* Of the Crandall Engineering Company, East Boston, Mass.

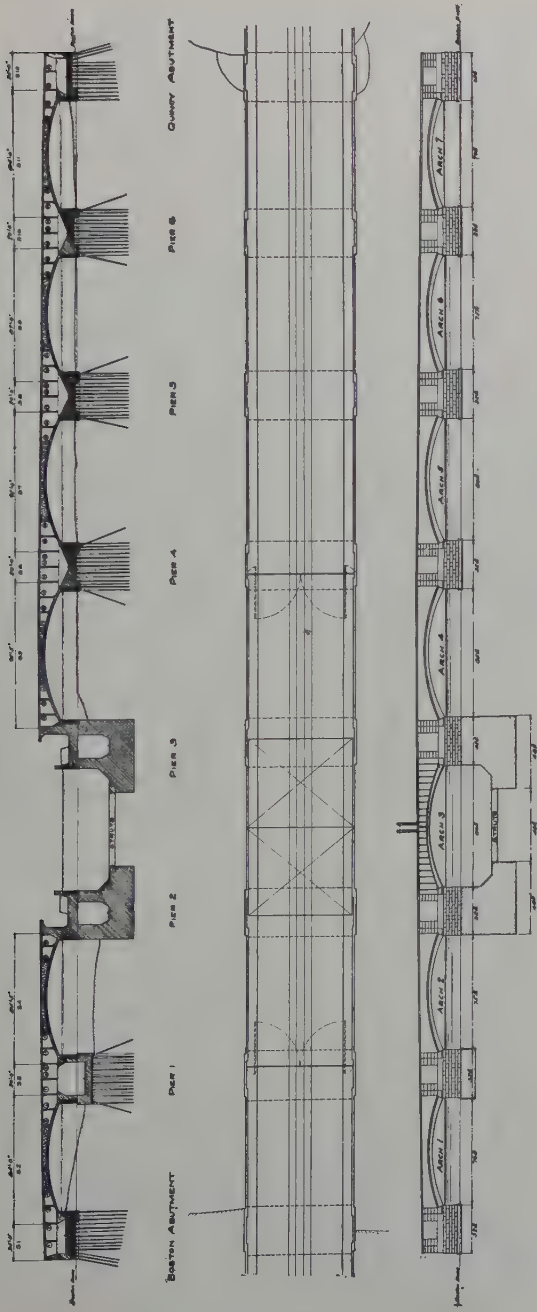
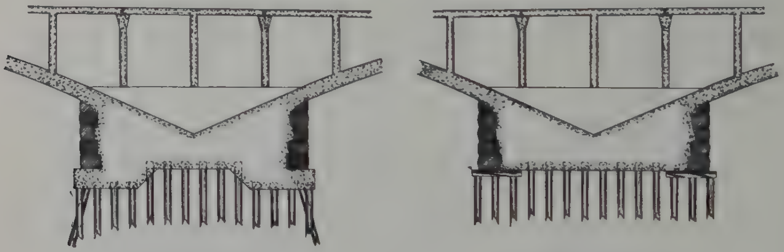


Fig. 1. — Key Layout of Neponset Bridge
Built for Metropolitan District Commission by The Crandall Engineering Company, Boston

In July, 1922, the Crandall Engineering Company was awarded the contract for this work. Construction was begun immediately under the superintendence of W. L. Blanchard. Benjamin Davis was resident engineer for the Commission. The first operation was to dredge out the pier sites for Piers 4, 5 and 6, where the mud was above the pile cut-off line and above low water. These areas were dredged to 2 feet below the cut-off. The piling of spruce was then driven to refusal with a floating pile driver equipped with a No. 2 Warrington steam hammer. A large portion of these piles could be driven at all stages of the tide, the driver at low tide floating in the dredged basin of each pier. The latter part of the driving had to be done during the upper half of the tide. Similarly the site of Pier 1 was dredged to 2 feet below the pile cut-off which on this pier was well below low water, so there was no great difficulty in driving the piles.

Some of these piles when driven nearly to refusal would suddenly drop several feet before again bringing up. The inspector kept driving the piles hard for some time so as to penetrate this "soft stratum" which did not show on any borings. Finally an oak pile was driven to refusal. The soft stratum immediately disappeared. This is an obvious lesson in overdriving. Some of the spruce piles which had penetrated this "stratum" were pulled up and all found broken.



Pier Foundations
As Constructed

Pier Foundations
Original Design

FIG. 2. — PIER FOUNDATIONS

The piles were cut off to proper grade with a submerged circular saw on a vertical shaft operated from a pile driver. After the piles were cut in Piers 4, 5 and 6 gravel fill was placed up to the concrete line. On Pier 1 the gravel fill was placed around the piles after the cofferdam sheeting was in place. The foundations for the abutments were similarly built, except that the excavation was done by derrick and clam-shell bucket, and the piles cut off by hand.

On these gravel beds and around the pile heads a concrete mat of 1:3:6 concrete was placed 3 feet thick to the bottom of the granite facing. Several courses of this facing were then laid and the mass concrete core poured inside. This was done by tide work to avoid cofferdams. At the proper time the arch reinforcing extensions were embedded in the concrete cores.

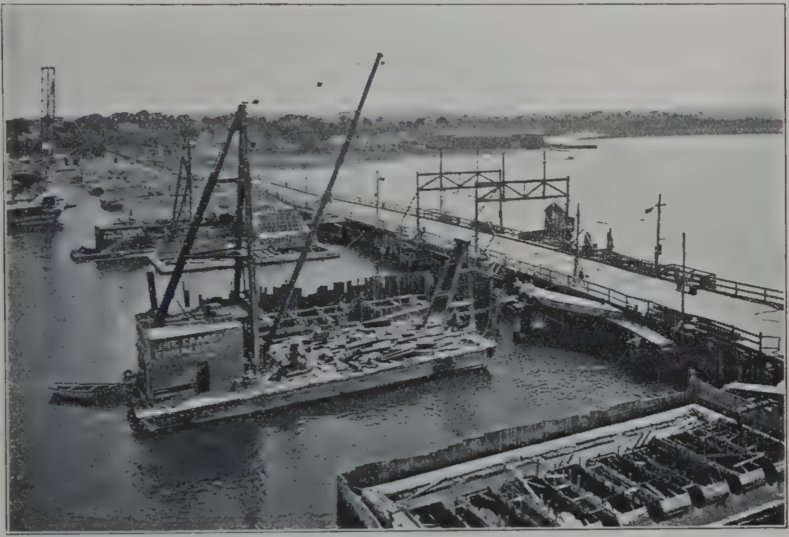


FIG. 3. — BIRD'S-EYE VIEW SHOWING PIERS UNDER CONSTRUCTION

CONSTRUCTION OF CHANNEL PIERS

The construction of Piers 2 and 3 presented the most difficult problems encountered. Pier 3, south of the channel, was the first to be constructed. The original plans called for the bottom of these piers at elevation — 29 resting on timber piling and the use of 48-foot steel sheet piling. After the contract was signed the Commission took additional explorative borings in the channel, and at the end of three weeks decided to carry the foundations down to elevation — 37 where adequate bearing was available without the use of bearing piles. This deeper foundation called for the use of 60-foot 14-inch Lackawanna arch-web steel piling. Unfortunately the delay brought us into the period of the coal strike with the steel mills shut down, and resulted in the steel not being delivered until September, and forced the cofferdam work into the winter, with resulting expense and loss of time.

Meanwhile the site of this pier was dredged to elevation — 37 allowing the material to take its slope. Guide piles and walings were driven and placed so that when the steel arrived it could be immediately placed. The 60-foot lengths of steel were unwieldy pieces to handle. They were placed by a floating derrick with a boom 95 feet long, starting from one side and continuing around the piers, being simply set on end without driving. When all were placed and the shutter in position they were then driven with a No. 7 McKiernan-Terry Hammer. This gave a penetration of about 5 feet.

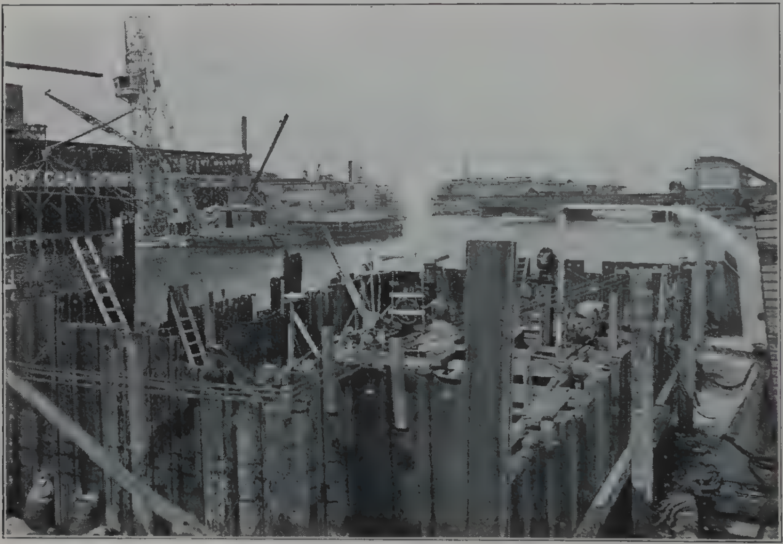


Fig. 4. — Cofferdam for Pier 2

With the original piling foundation a seal coat 9 feet thick had been specified, and the same depth of seal coat was called for on the new depth without the piling. We found that with the possibility of hydrostatic pressure under the concrete a seal coat 20 feet thick would be required to overcome it. It was finally decided to use a seal coat 17 feet thick, making the top at elevation — 20. This seal coat of 1:2:4 concrete was placed in a 2-cubic yard bottom-dump concrete bucket filled from the floating concrete plant.

The seal coat being in place, the bracing was assembled inside the dam and lowered to proper elevation and struts placed by diver between the top of the seal coat and bottom row of bracing. The dam was pumped down with two 10-inch and one 12-inch steam centrifugal pumps. As the water was lowered the bracing was adjusted and wedged at each row. Some difficulty was encountered with the ice which had formed inside the dam. This was in January, 1923. The surface of the seal coat was found fairly level and with but little laitance. This was cleaned off and the concrete picked. Forms were placed and the concrete poured by the floating concrete plant in lifts up to the bottom of the lower bracing. This bracing was then shifted and another lift placed, and so on, until the granite course was reached. The granite was laid in several courses and backed with 1:3:6 concrete to elevation + 6. From the time the dam was first pumped down until the pier was complete above high water required four months. The severe winter weather was an important factor in this time interval. During this time the dam was kept pumped out with one 10-inch pump operated a few minutes each hour.

The only leaks were in the joints between the steel piling, and these leaks were stopped by dropping cinders outside, which were sucked into any openings. The different pressures between low and high tide caused the sheeting to work and necessitated attention to these small leaks at nearly every tide.

This pier being completed the sheeting was pulled and driven for Pier 2, the other draw-span pier. This was a duplicate of Pier 3. Due to the pier base extending into the channel and obstructing traffic, the seal coat was brought up to elevation — 23 and then a cut-off wall of 6-inch groove and spline sheeting was placed across the dam 14 feet from the southerly wall, and the steel sheeting to the south of this cut-off wall removed so as to clear the old channel. The seal coat was then continued to elevation — 20. The bracing was then placed as in the previous dam and the dam pumped down, using two 10-inch steam pumps and one 6-inch vertical electric pump of our own design. The pumping operations required four hours. This dam was particularly tight, being kept unwatered by the 6-inch electric pump operating a few minutes each hour. From the time the dam was first pumped down until the pier was complete took five weeks.

After Piers 2 and 3 were completed, four reinforced concrete struts were placed under the channel between the pier footings and in pockets previously cast in them. The struts measured 48 inches deep by 44 inches wide and 55 feet long, weighing 60 tons each. These were placed by two lighters and then grouted into the pockets.

Pier 1 was built in a cofferdam of 4-inch grooved and splined sheeting. A seal coat of 1:2:4 concrete 7 feet thick was placed with a 2-cubic yard submarine bottom-dump bucket. The timber bracing was then built in place, the dam pumped out and the granite facing and concrete core built as in the others.

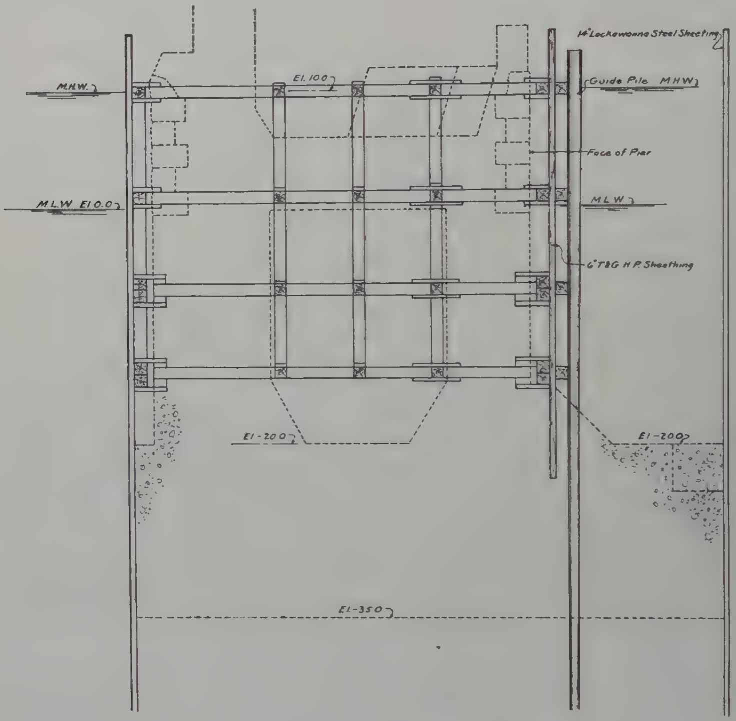


FIG. 5. — CHANGE IN COFFERDAM, PIER 2

CONSTRUCTION OF ARCHES

For the arch centering it was decided to use the steel type which was designed and furnished by the Blaw Knox Company, constructing the arches in thirds divided longitudinally. The centering was hung from structurals fastened to bolts embedded in the piers, and acted as an arch in supporting the weight of the concrete. Sufficient centering was provided for four arches. These were the first placed on the westerly side of arches 4, 5, 6 and 7. The portion of arch 7 with its voussoir ring was poured first, with arches 6, 5 and 4 following in turn. It was found that this type of centering deflected from 1½ inches to 2 inches under loads. After eighteen to twenty-one days the centering was struck, lowered on to rollers on transverse pile bents, and rolled into position for the middle third and then for the last third. After the centering was relieved from arches 5 and 6 it was transferred to Arches 2 and 1, respectively, which were of the same corresponding span. Here the operations were repeated.

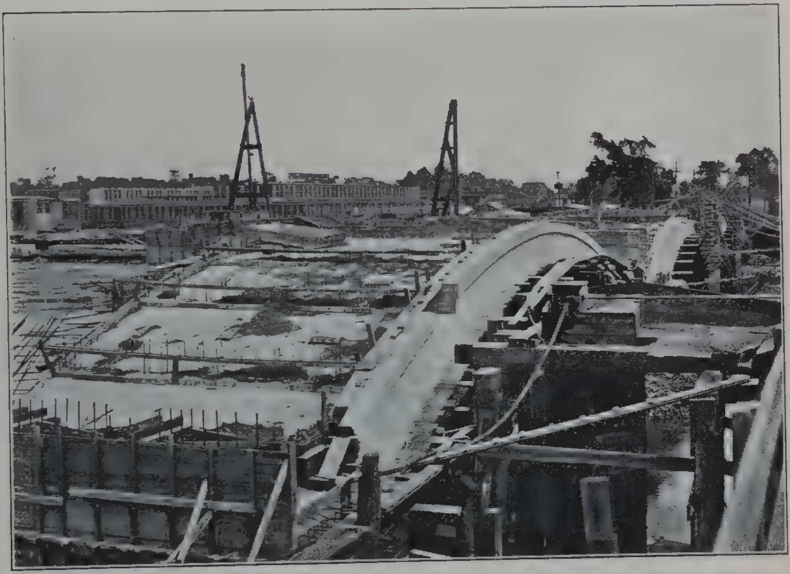


Fig. 6. — First Third of Arch Rings

Arches 5, 6 and 7

The arches are 20 inches thick at the crown, with a radius of 91 feet for the intrados. They are reinforced longitudinally with 1-inch round bars top and bottom spaced 8 inches center to center.

Meanwhile the forms for the spandrel and interior walls were placed. As the centering was struck these walls were poured. Then the floor forms were placed and the pavement concreted. As the floor slabs over the haunches were completed, fill was trucked over them for the crown, where it was compacted in place and these portions of the pavement concreted. Then followed the laying of the street car tracks with their granite block paving, the sidewalk slabs and the wall coping.

The draw-span is a two-leaf Shertzer Rolling Lift Bridge with a total span of 80 feet. The mechanism is operated by four 10-h. p. motors with 2-h. p. motors operating the traffic gates. The lines of this span are designed to conform to the curve of the 80-foot arch. The paving of the draw is of creosoted wood blocks with an asphaltic filler, and is attached frequently to transverse angles. Structural portals to support the trolley wires are provided at the outer end of each leaf and on each draw pier. This draw-span was fabricated by the Boston Bridge Works as subcontractor, and erected by them under the direction of Mr. J. D. Campbell.

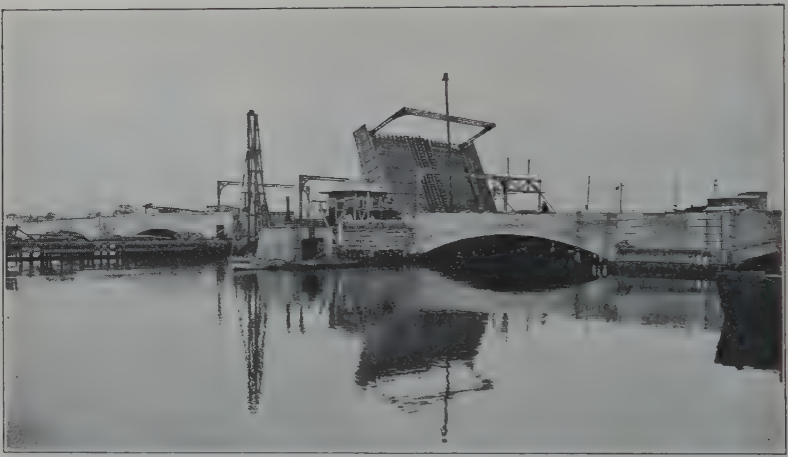


FIG. 7. — BOSTON END AND DRAW BRIDGE

PUBLIC SERVICE LOCATIONS

A description of the public service locations may be of some interest. The gas and water pipes are placed under the westerly sidewalk slab and connected at the draw with the old siphons build in 1917. The duct lines of the New England Telephone and Telegraph Company and the Edison Company run under the easterly pavement slab. The telephone company crosses the channel with submarine cables. The Edison company used a new type of submarine conduit of unique type designed by J. R. Worcester & Co.

This conduit consists of a steel shell in the shape of the letter U with sloping arms. The bottom portion is rectangular in cross section, with flanged joints at each end for connecting the end sections. These end sections are tubular, 54 inches in diameter, and bolted to the bottom section with a rubber gasket in the joint. In this casing are twelve 4-inch fibre conduits encased in concrete reinforced longitudinally with 1-inch rods with ¾-inch hoops every 24 inches.

The bottom section of the shell was erected on a timber platform with a piling foundation built between low and high water mark. The fibre ducts were placed in this shell and the whole concreted. This section was then lifted by two lighters and towed to position over the channel. Here the tubular end sections were fastened in place and the whole lowered into a trench previously excavated. The end sections were pumped out and the ducts and concrete placed in the dry. This is the first known installation of this type of submarine crossing for cables.

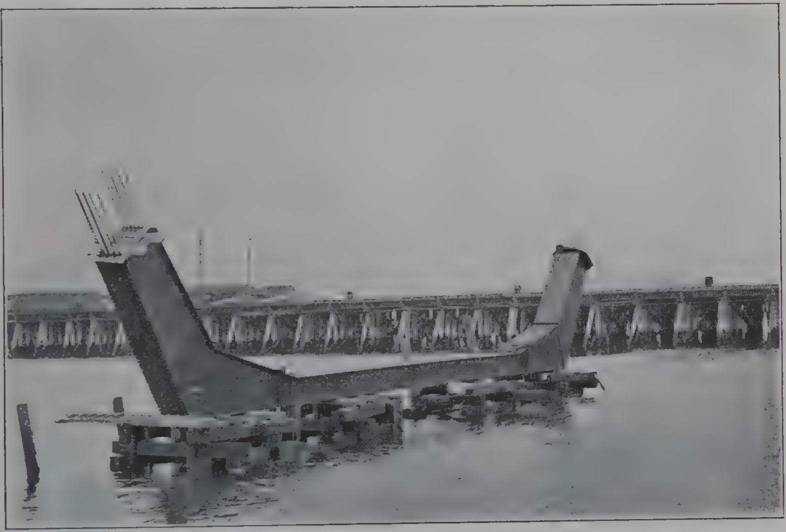


FIG. 8. — BOTTOM SECTION OF SUBMARINE CONDUIT

Edison Electric Illuminating Company of Boston

PLANT

It was decided to use largely floating units on account of their flexibility. A short narrow pier was built on the Quincy side for handling materials to and from these floating units. The piles were driven from a floating pile driver using a No. 2 Warrington steam hammer, the piles being delivered in rafts alongside the driver. As previously stated, the piles were cut, using a vertical circular saw mounted in the leads of the floating pile driver. For erecting masonry, steel piling and other materials, derrick lighters were used. One of these was self-propelled for handling and transporting materials from the cars to the site. The floating concrete plant was perhaps the most unique unit. Due to the limitations of the site and the lower cost of sand and gravel delivered by barges this type of plant was decided upon. It consisted of a 40-foot by 60-foot lighter on which was mounted an 87-foot steel tower braced by four steel stiff legs. Immediately back of this tower were mounted a 1 cubic yard Smith tilting concrete mixer with overhead bins and batch hopper. The cement was stored at one side near the tower. From there the bags were dumped into the hopper of a bucket elevator which delivered the cement to a measuring hopper under the bins. At the other side of the deck was the hoisting engine for lifting the tower bucket. The sand and gravel bins were filled from scows alongside by a stiff-leg derrick and clam-shell bucket. The derrick engine was located at the aft of the scow. At this end, also, was a large boiler which furnished steam for the entire plant. The lower was equipped with boom and counterweight chutes giving a 94-foot radius of delivery for the concrete. All of the concrete was mixed and placed by this machine, except some of the paving when it was not found economical to operate for small quantities. In placing the underwater concrete in the cofferdam the

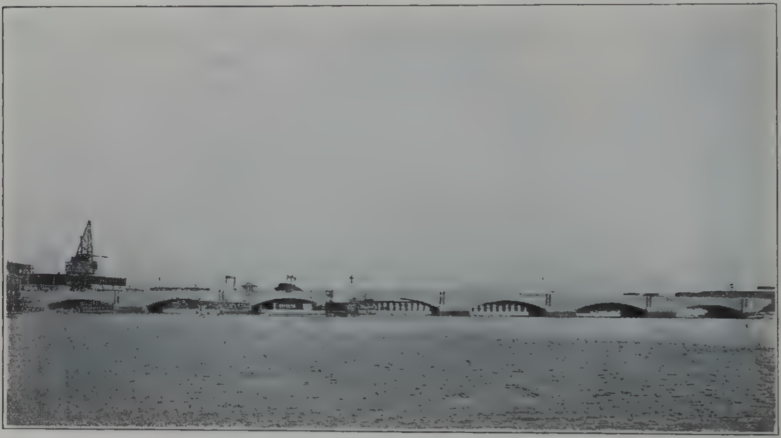


FIG. 9.— NEPONSET BRIDGE AS COMPLETED

concrete was spouted into a hopper on a lighter, and from that into a 2-yard bottom dump bucket which was lowered into place by the derrick on the lighter. When going at full capacity this machine could mix and place concrete for about 90 cents per cubic yard.

For the two abutments which could not be reached by lighters, derricks were used for excavation and material handling. The concrete was within reach of and placed by the floating mixing plant.

Some of the smaller quantities of concrete in the pavement, sidewalks and copings were mixed in a 1-bag mixer with concrete materials delivered in trucks.

On the space at the Quincy side were located auxiliary plant consisting of air compressor, sawmills, planers, band-saws, etc., reinforcing yard with benders and shears, storeroom and office.

OF GENERAL INTEREST

AIRPLANE TO AID IN MAPPING

Co-operation of U. S. G. S. and State Highway Department Ensures Completion of New Hampshire Maps

The appropriation of $25,000 a year for five years by the legislature of the State of New Hampshire for co-operation with the United States Geological Survey ensures the completion of the topographical mapping of that state in the near future. Although isolated parts of New Hampshire have been mapped, particularly along the Massachusetts border and in the White Mountains, the greater portion of the state will be done under this co-operative arrangement with the Geological Survey.

An important feature of the work will be the use of aerial photographs. It is planned to have the State of New Hampshire photographed by the Army Air Service during the progress of the topographical mapping, in order that the data thus obtained may be available for use in connection with the mapping, which was started on May 1. It is expected that the data secured from these photographs will materially reduce the expense of the topographic mapping, it being estimated that the saving will be approximately 25 per cent of the cost of such mapping, without the aid of the photographs. Although the length of time necessary to secure the air photographs depends entirely on good flying weather, it is not expected that it will take more than three months to cover the southern half of the state, which is to be done first.

The use of aerial photographs in connection with topographic mapping is confined principally to taking from them certain data, such as the location of roads, streams, houses, boundaries of timber areas, which are transferred and adjusted to geographical location established by ground methods on the plane table sheets. The photographs do not constitute a map, but the information shown on them does materially reduce the time and cost of securing such data, and, when accurately controlled by ground methods, furnishes an excellent base on which the engineer can, by means of plane table and stadia, construct a contour map showing the relief of the area and such other features of the topographic map as can be secured only by well-established ground methods.

Although the use of airplane maps as an aid in the preparation of United States Geological Survey maps is a fairly recent development, it has already proved most successful.

The State of New Hampshire is to be congratulated on having a legislature that has realized the economy of providing sufficient appropriations to ensure the completion of the mapping of the entire state within a reasonable time. The Highway Department, the Public Service Commission, and the Forestry Department were all interested in this project, and this appropriation of $25,000 a year for the period of five years was made from the Highway Fund.

Although Massachusetts was one of the earliest states to have its entire area mapped, much of this being done forty years ago, the existing maps were executed when the methods and standards of accuracy were not as high as are now considered necessary for engineering purposes. A resurvey of this state would supply data of great value to the engineers and to the general public. It is hoped that in the near future Massachusetts will provide funds to co-operate with the Geological Survey for a resurvey of the state.

Forty-Foot Channel for Boston Harbor

The allotment of $450,000 for Boston Harbor will result in the deepening of Broad Sound Channel from President Roads to the sea from 35 feet to 40 feet at mean low water. About $410,000 of the allotment is available for this specific project, and it will probably be sufficient to do the major portion of the work.

Although congressional authority had been received for the deepening of the channel, no funds had previously been provided by the War Department. Several months ago Major Godfrey, District Engineer, Boston Engineer District, held a hearing relative to this matter, at which much evidence was submitted by the Navy Department, the Boston Chamber of Commerce, the Port of Boston Committee of the Affiliated Technical Societies of Boston, and others, showing Boston's need of this work. As a result of this hearing Major Godfrey reported favorably to the Chief of Engineers, and the money for carrying it out is now available.

Two New Publications

Two publications containing much valuable information about Boston have recently been issued by the Boston City Planning Board. The first of these, "Zoning for Boston — A Survey and a Comprehensive Plan," bears this foreword:

> On the eve of celebrating, in 1930, the tercentenary of the founding of Boston, a Zoning Plan has been made for directing a more orderly growth of the city during the centuries to come than has prevailed in the past three hundred years. With equal rights for all and special privileges for none, the Plan will protect every district from detrimental property uses, preserving home neighborhoods, encouraging the most valuable development of business and promoting sound industrial expansion.

This report tells of the conditions in Boston, the growth of the zoning movement and the final enactment of a zoning law for Boston. A copy of the act (chapter 488 of the Acts of 1924), in effect June 5, 1924, together with numerous maps used in connection with the study, are included in this publication.

Those interested in city planning, particularly along zoning lines, will find much valuable material in this report. Many of the members of the Boston Society of Civil Engineers are engaged at the present time in city planning activities in the municipalities of eastern Massachusetts, and "Zoning for Boston" should prove of much interest to them.

The other publication by the City Planning Board is "A Compendium of Reports and Studies Relating to the Commerce and Industries of Boston," and it is a rather unique volume. Its purpose is to "index and condense the best of the material which has been made available through the almost unlimited number of reports which have been published since 1844, when Robert Fleming Gourlay offered his partly fantastic and wholly fascinating plan for 'Enlarging and Improving the City of Boston' . . . and to give it such order and arrangement that a summary of the documents themselves will reveal the commercial problems of the city, the forces approaching them, the solutions thus far proposed, and the efforts made to carry them into effect."

The abstracts of "reports and studies" relating to commerce and industry include publications of the federal, state and city governments, the Boston Chamber of Commerce, and of other organizations and individuals.

The abstracts of publications on "related subjects" include general city planning, "Greater Boston," metropolitan highways and transportation, industrial education, market problems, housing and zoning.

In an appendix appears a chronological summary of the principal investigations and of developments covering almost a century and including about fifty items, from the establishment of the harbor lines by the Legislature in 1837 up to the zoning statute and the bill providing for the "Northern Gateway" in 1924.

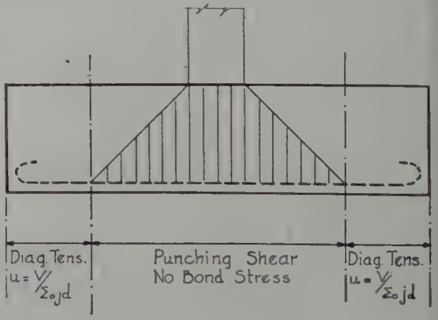
Other appendices contain additional information of value to any one making a study of Boston — past, present or future. Briefly, this volume presents for the first time *under one cover* references to substantially all reports and studies relating to commerce and industries of Boston with abstracts of the more important material. The preparation and publication of this "Compendium" and of "Zoning for Boston" furnishes still further proof of the service which the City Planning Board is rendering to Boston.

Bond in Footings

By Edwin S. Parker, of J. E. Hanlon & Co., Structural Engineers, Boston

The Boston Building Law simply says that the allowable bond stress in footings shall not be exceeded. If we take the bond at the face of the column by the usual formula we find that we must either use more steel than is required for bending or use a lot of bars so small as to be absurd, — ⅜ inch round or smaller, — and this is obviously poor practice.

But there is another paragraph which says that diagonal tension shall be measured at a point distant from the face of the column equal to the depth to the steel. In other words, there is not diagonal tension but punching shear within the 45-degree line.



We know that the bond stress is due to change in horizontal shear, for the increment of horizontal shear must be taken up by the bars throughout the beam if the concrete and steel are to form an integral unit. So if within the 45-degree lines we have vertical shear and no diagonal tension, there can be no horizontal shear, for diagonal tension is the resultant of these two, and if there is no horizontal shear there can be no bond stress. Thus we see that bond stress begins at the 45-degree lines, the same point at which diagonal tension begins, and on this basis bars of reasonable size can be used without exceeding bond.

From this we can see also that the area within the 45-degree lines is stressed in arch action, for there is no horizontal shear and hence no change in tension on the bar. Therefore beyond this area we must provide anchorage, besides seeing that the bond stress is not exceeded, and so the bars should be hooked.

This interpretation of the law will save much hardship and expense by avoiding an excess of steel or a lot of small bars, and will give a reasonable and sensible design for footings.

Library Books for Sale

Considerable progress has been made in revising the library of the Boston Society of Civil Engineers, and in recataloguing the more recent books in accordance with L. C. (Library of Congress) classification. In connection with this work numerous periodicals and documents and duplicate books have been set aside which it is desired to dispose of in order to secure needed space. In most cases these periodicals and documents are odd volumes or belong to sets which it does not appear feasible to maintain in our library.

Before disposing of this material to book dealers or to other libraries, the Board of Government has decided to offer these for sale to *members of the Society*. Funds received will be used for the purchase of additional books and for continued improvement of the library.

The Board requests the members to look over the following lists and to submit bids for any of this material which is desired before June 15, after which date it will be offered to libraries and book dealers.

Periodicals

American Journal of Science and Arts, 2d ser., v. 5–16, May, 1848–Nov. 1853 (bound in 6 v.); 3d ser., v. 9, Jan.–June, 1875; 11, Jan.–June, 1876; 13–16, Mar. 1877–Dec. 1878

American Machinist, v. 27, pt. 1–v. 29, pt. 1, Jan. 1904–June, 1906

American Society of Civil Engineers. Transactions v. 52, 54, 81, 83, 84, 86, 87. Index v. 1–83 (1867–1920).

Appleton's Mechanics' Magazine and Engineers' Journal, v. 1, 1851

The Artizan (London), v. 1–25, 1844–67 (bound in 10 v.)

Association of Engineering Societies. Journal:
  One set v. 2–49, Nov. 1882–Dec. 1912 (v. 1, 7, 18, 19, 44 lacking)
  One set v. 9–47, Jan. 1890–Dec. 1911 (v. 44–46 lacking)

Boston Society of Civil Engineers. Journal, v. 1, 1914 (2 cop.)

—— Monthly bulletin 1–37, 1906–09

General contractors' association. Bulletin, v. 5–9, 1914–19

Journal of Science and the Arts, v. 1–5, 1817–18 (bound in 2 v.)

Machinery, v. 11–13, Sept. 1904–Aug. 1907

Mechanics' Magazine (London), v. 2–4, 6–13, 1824–25, 1827–30

Mechanics' Magazine, museum, register, journal and gazette, v. 34–42, Jan. 1841–June, 1845

Popular Science Monthly, v. 35, 1889

Science, v. 1–5, Cambridge, Feb. 1883–June, 1885; v. 6–12, New York, July, 1885–Dec. 1888

Documents

Ayres. The war with Germany, a statistical summary. 1919

Canada. Dept. of Railways and Canals. Report of the Chief engineer of canals, 1880. (Paper)

International Boundary Commission. Joint report upon . . . the international boundary between the U. S. and Canada in accordance with the . . . convention signed at Washington April 21, 1906

Marcy, R. B., and G. B. McClellan. Exploration of the Red River of Louisiana in the year 1852

Poore, B. P. Descriptive catalog of the government publications of the U. S., Sept. 5, 1774–Mar. 4, 1881

Schroeder, Henry. History of electric light. 1923 (Smithsonian misc. coll. v. 76:2). (Paper)

U. S. Geological and Geographical Survey. 12th annual report of the territories . . . Wyoming and Idaho, for the year 1878. Pt. 2, Yellowstone national park

U. S. National Coast Defense Board. Report, 1906

U. S. President. Message . . . on the subject of California and New Mexico, Jan. 24, 1850

U. S. Senate. Comm. on Pacific railroads. Report on the policy of extending government aid to additional railroads . . . 1869. (Paper)

U. S. State Dept. Reports upon the survey of the boundary . . . from the Lake of the Woods to the summit of the Rocky mountains. 1878. (2 cop.)

U. S. War Dept. Report on bridging the Mississippi River between St. Paul, Minn., and St. Louis, Mo. 1878. (Paper)
—— Reports of explorations and surveys to ascertain the most practicable . . . route for a railroad from the Mississippi River to the Pacific Ocean, 1853–4. 12 v. (2 cop. v. 11)
—— Survey of waterway from Lake Michigan to Illinois river at La Salle . . . 1890

Miscellaneous

29 volumes of pamphlets on railroads, canals, water works, etc. Privately bound, without index. 1835–1880 approximately.

Architecture

Brown. Domestic architecture. 2 v. 1843
Degen. Motive zu ornamental zimmerwerken. n. d.
Designs for chimney-pieces with mouldings and bases at large, on 24 plates. n. d.
Description of Tremont house. n. d.
Durand. Partie graphique des cours d'architecture. 1821
Feuchère. L'Art industriel . . . et de decorations intérieures. 72 pl.
Goodwin. Domestic architecture. 1843. 2 v.
Lamb. Studies of ancient domestic architecture. 1846
Lang. Highland cottages at Roxbury. 1845
Owen. Hints on public architecture. 1849.
Robinson. Designs for farm buildings. 1847.
—— Designs for ornamental villas. 1836
—— Designs for ornamental cottages. 1836
Ruskin. Stones of Venice. Wiley, 1851
Thomas. Designs for monuments and chimney pieces. 1843
Vitruvius. Civil architecture, tr. by Wilkins. 1812

General Engineering

Adams, A. D. Electric transmission of water power. 1906
Adams, B. B. Block system. 1901
Allen. Railroad curves and earthwork. Spon, 1894
American society of civil engineers. Index to transactions v. 1–45, 1867–1901; v. 46–59, 1901–07; v. 1–74, 1867–1911. (2 cop.)
Austin. Examples in alternating currents, v. 1. 1915
—— How to make low-pressure transformers. 2d ed., 1915
Barr. Pumping machinery. 1893
Baumeister. Cleaning and sewerage of cities. 1891
Bell. Principles of the manufacture of iron and steel. 1884
Bolton. Motive powers. 1895. (2 cop.)
Borden. System of useful formulæ . . . for locating and constructing railroads. 1851. (2 cop.)
Boston, Mass. History of the Boston waterworks from 1868–76
—— History of the introduction of pure water into the city of Boston. 1868
Boston electrical handbook. Sept. 1904
Bourne. Catechism of the steam engine. 1859; copy 2, 1864
Box. Practical hydraulics. 1876
Brice. The law . . . relating to tramways and light railways. 2d ed., 1902
Buel and Hill. Reinforced concrete. 1904
Cain. Maximum stresses in framed bridges. 1878
Cummings. American cements. 1898
Davies. Surveying. 1835
Dempsey. Tubular and other iron girder bridges. 1850
Duncan. Chemistry of commerce. Harper, 1907
Fanning. Water-supply engineering. 1877.
Fowler. Coffer-dam process for piers. 1898
Freeman. Hetch-Hetchy . . . water supply of San Francisco. 1912
Frizell. Water power. 1901
Gillette. Handbook of cost data. 1st ed., 1906; 2d ed., 1910
—— Rock excavation. 1904
Glynn. Construction of cranes. 2d ed., 1854
Goodhue. Municipal improvements. 1893
Gotshall. Notes on electric railway economics. 1903
Gurley. Manual of . . . instruments. 31st ed., 1895
Guyot. Where and why public ownership has failed. 1914
Hadley. Railroad transportation. 1892
Haupt. General theory of bridge construction. 1851
—— Manual of engineering specifications and contracts. 1878
—— Move for better roads. 1891
Herrick. Practical electric railway handbook. 1901
Holley & Ladd. Analysis of mixed paints . . . 1908
Houston. Dictionary of electrical words. 2d ed., 1892
Jacob. Practical designing of retaining walls. 1873
Johnson. Theory and practice of surveying. 1886
Joint N. E. railroad committee. Report to the governors of the New England states. June, 1923
Latham. Sanitary engineering. 1877. (2 cop.)
Mahan. Civil engineering. 1846
Manual of American water-works. 1897
Merriman. Hydraulics. 2d ed., 1890
Meyer, B. H. Railway legislation in the U. S. 1903. (2 cop.)
Meyer, H. R. Municipal ownership in Great Britain. 1906
Molitor and Beard. Manual for resident engineers. 1903
Neville. Hydraulic tables. 2d ed., 1860–1
Ogden. Sewer design. 1899. (2 cop.)
Parsons. Track. 1886
Patton. Practical treatise on foundations. 1898
Pencoyd iron works. Wrought iron and steel. 8th ed., 1892
Pender. American handbook for electrical engineers. 1st ed. 1914

Permanent international assoc. of navigation congresses. Shipbuilding from its beginnings. 3 v.
The plane table . . . from papers of the U. S. Coast Survey. 1869
Pratt. State railways. 1907
Pratt and Alden. Street railway roadbed. 1898
Rafter and Baker. Sewage disposal in the U. S. 1894
Skinner. Types and details of bridge construction. Part 1, Arch spans. 1904
Snow. Principal species of wood. 1903
Soper. Modern methods of street cleaning. 1909
Spring valley water company. Future water supply of San Francisco. 1912
Standard handbook for electrical engineers. 2d ed. 1908
Taylor. Practical cement testing. 1906. (2 cop.)
Thurston. Growth of the steam engine. 1878
Tillson. Street pavements and paving materials. 1900
Trautwine. Civil engineer's pocket-book. 16th ed. 1893
Ure. Dictionary of arts, manufactures and mines. 1854
Vose. Handbook of railroad construction. 1857
—— Manual for railroad engineers. 1873. (Text only)
Wait. Engineering and architectural jurisprudence. 1898
Weisbach. Mechanics of engineering. 1870. (v. 1 only)
Woodbury. Fire protection of mills. 1882
Wright. Mortars . . . at the public works in Boston harbor. 1854

PROCEEDINGS

MINUTES OF MEETINGS

Boston Society of Civil Engineers

April 15, 1925. — A regular meeting of the Boston Society of Civil Engineers was held this evening in Chipman Hall, Tremont Temple, and was called to order by the President, Richard K. Hale, at 7.15 p.m. There were 95 members and guests present.

The reading of the minutes of the previous meeting was omitted. These were printed in the April Journal.

The Secretary reported for the Board of Government the names of those elected to membership:

Members: Harry P. Burden, James D. Campbell, Richard S. Chatfield, John C. Dingwell, William M. B. Freeman, LeRoy M. Hersum, Walter A. Raney, Edwin H. Wright. *Junior:* Joseph E. Theriault.

The President stated that an Affiliation meeting would probably be held in May and also that the Society had been invited to join the New England Water Works Association in a visit to the works of the Providence Board of Water Supply on June 23 or 25, 1925. It was Voted that the Board be empowered to change the date or to omit the May meeting and to make arrangements for an excursion to take the place of the June meeting.

The President then introduced Brigadier-General R. C. Marshall, Jr., General Manager of the Associated General Contractors of America, Inc., who spoke on various problems of the construction industry. General Marshall's principal topics were "the use of day labor by municipal, state and governmental boards on construction work; the present bonding practices in the construction industry and the need for improvement; and uniform contract forms."

After General Marshall's address there was a discussion in which Leonard C. Wason, William F. Williams and Frank M. Gunby took part. At the close of the meeting, the Society accorded General Marshall a rising vote of thanks for his kindness in coming to Boston and presenting such an interesting address.

Adjourned at 9.30 p.m.

J. B. Babcock, *Secretary.*

Designers Section

April 8, 1925. — The regular April meeting of the Designers Section of the Boston Society of Civil Engineers was called to order at 6 P.M. in the Affiliation Rooms.

The minutes of the March meeting were read and approved.

The chairman introduced Mr. Frank E. Winsor, Chief Engineer of the Water Supply Board of the City of Providence, R. I., who spoke on "The New Water Supply of the City of Providence", illustrating his talk with a number of lantern slides.

There were 38 members and visitors present. The meeting was adjourned at 7.15 P.M.

SCOTT KEITH, *Clerk.*

NORTHEASTERN UNIVERSITY SECTION

MAY 1, 1925. — The annual meeting of the Northeastern University Section of the Boston Society of Civil Engineers was called to order at 6.30 P.M. at the University, with Chairman Sidney S. Anthony presiding.

Nominations for officers for the ensuing year were made from the floor. The following were elected:

Chairman — Sidney S. Anthony.
Vice-Chairman — Roger G. Witherell.
Clerk — Carl A. Wolfrum.
Executive Committee — Fritz F. Hampe, F. Vincent Britt, Joseph E. Theriault.

The Chairman then delivered a brief Address, reviewing the past year, and thanked the members for their co-operation which had helped to make the past year's activities of the Section one of the biggest successes in its history. He also thanked the members for the honor of being re-elected to the office of Chairman of the Section for the ensuing year. The business meeting adjourned at 7.15 P.M.

The Chairman then introduced the President of the Boston Society of Civil Engineers, General R. K. Hale.

General Hale, after giving a brief history of the organization and relating the benefits derived from an engineering society, gave an illustrated lecture on "River and Harbor Improvements in Massachusetts." Being directly connected with the Waterways Division of the Commonwealth, he delivered to the members much first-hand information which could not have been obtained from any other source than actual experience.

The meeting adjourned at 9.15 P.M.

WILBERT H. CONNOR, *Clerk.*

APPLICATIONS FOR MEMBERSHIP

[May 15, 1925.]

THE By-Laws provide that the Board of Government shall consider applications for membership with reference to the eligibility of each candidate for admission and shall determine the proper grade of membership to which he is entitled.

The Board must depend largely upon the members of the Society for the information which will enable it to arrive at a just conclusion. Every member is therefore urged to communicate promptly any facts in relation to the personal character or professional reputation and experience of the candidates which will assist the Board in its consideration. Communications relating to applicants are considered by the Board as strictly confidential.

The fact that applicants give the names of certain members as reference does not necessarily mean that such members endorse the candidate.

The Board of Government will not consider applications until the expiration of twenty (20) days from the date given.

For Admission

BERESTNEFF, BORIS, Boston, Mass. (Age 36, b. Kiew-City, Russia.) Graduate of Institute of Technology in Kiew, 1914; in Russian army for three years; 1920–21 manager and owner of mechanical workshop in Constantinople, and director of the Chaffeur School in same city; 1923–25 with Stone & Webster, Inc., engineering department; at present assistant engineer in transit department, city of Boston. Refers to H. B. Alvord, S. K. Cohen, L. S. Cowles, C. S. Ell, W. E. Nightingale.

Caddigan, Michael James, Forest Hills, Mass. (Age 32, b. Boston, Mass.) Graduate of grammar school, Brighton High School for three years. Was in the employ of his father, J. Caddigan, General Contractor, until 1917, when he enlisted in the 101st Engineers. Returned from France in 1920 and entered Franklin Union, where he remained until 1922, when he entered the employ of Clifford & Roeblad under U. S. Government; with Charles R. Berry Drafting Service, 1924–25. He holds an A B C Building license, city of Boston. Has had five courses in University Extension, State House. Refers to C. R. Berry, W. W. Clifford, Hyman Felderman, J. A. Howe.

Mathers, Ernest, Milton, Mass. (Age 22, b. Johnsonburg, Pa.) Student at Northeastern University. Refers to H. B. Alvord, C. S. Ell, J. W. Ingalls, W. E. Nightingale.

Pagliarulo, Joseph Francis, East Boston, Mass. (Age 22, b. Boston, Mass.) Student at Northeastern University. Refers to W. J. Alcott, Jr., H. B. Alvord, C. S. Ell, J. W. Ingalls, W. E. Nightingale.

For Transfer from Junior

Burke, George L., New York, N. Y. (Age 25, b. Norwood, Mass.) Graduate of Northeastern University in 1923. From April, 1917–November, 1917, was assistant to plant superintendent, Geo. H. Morrill Co.; November, 1917–November, 1918, assistant to engineer, town of Norwood; November, 1918–April, 1919, in U. S. Army; April, 1919–September, 1920, assistant to engineer, town of Norwood; September, 1920–June, 1923, Northeastern University; and June, 1923–July, 1924, superintendent, Allen Pope, Contractor, Washington, D. C.; August, 1924, to date, assistant chief of structures division, Murrie & Co., New York City, and at present is valuation engineer. Refers to H. B. Alvord, C. S. Ell, F. L. Flood, A. L. Maddox, G. A. Smith.

Harding, Arthur Edward, Boston, Mass. (Age 26, b. Boston, Mass.) Graduate of Northeastern University with degree of C.E.; 1918–19 was assistant estimator with George A. Fuller Co.; fall of 1919 to summer of 1920 draftsman with Monks & Johnson; fall of 1920 to spring of 1921, field engineer with Simpson Bros.; summer of 1921 assistant manager, Service Department, Gainaday Electric Co.; fall of 1921 to June, 1922, instructor in civil engineering, Northeastern University; summer of 1922 engineer on the Park Square building for W. A. and H. A. Root; October, 1922, to date, engineer and estimator for Simpson Bros. Refers to H. B. Alvord, C. S. Ell, J. W. Ingalls, C. F. Knowlton, W. E. Nightingale, R. E. Rice.

RECENT ADDITIONS TO THE LIBRARY

Analytical Geometry. L. A. Hopkins & A. Ziwet

Compendium of Reports and Studies relating to Commerce and Industries of Boston. City Planning Board

E M F Year Book. 1925

Fatigue Study. F. B. & L. M. Gilbreth

Psychology of Management. L. M. Gilbreth

Pulverized Fuel. L. C. Harvey

Readings and Problems in Statistical Methods. Horace Secrist

The Executive and His Control of Men. E. B. Gowin

The Public and Its Utilities. Wm. G. Raymond

Zoning for Boston. City Planning Board

NEW MEMBERS

Members

Harry P. Burden, 7 University Avenue, Medford Hillside, Mass.
Daniel E. Callahan, 27 New Park Street, Lynn, Mass.
James D. Campbell, 792 Beacon Street, Boston, Mass.
Richard S. Chatfield, 25 Walnut Place, Newtonville, Mass.
Wm. M. B. Freeman, 34 Chiswick Road, Brookline, Mass.
LeRoy M. Hersum, 52 Garden Court, Cambridge, Mass.
Edwin H. Wright, Tufts College, Mass.

Juniors

Joseph E. Theriault, 2 Estes Court, Everett, Mass.

DEATH

Frank T. Westcott . October 12, 1924.

Vol. XII MAY, 1925 No. 5

BOSTON SOCIETY OF CIVIL ENGINEERS

FOUNDED 1848

INDEX TO ADVERTISERS

	PAGE
Adams, H. S., 100–1 Ames Building, Boston	iii
Aspinwall & Lincoln, 46 Cornhill, Boston	iii
Associated Architects Printing & Supply Co., 25 Pearl St., Boston	x
Barrows, H. K., 6 Beacon St., Boston	iii
Bay State Dredging and Contracting Co., 62 Condor St., East Boston	x
Beattie, Roy H., 209 Bedford St., Fall River	ix
Bishop, J. W., & Co., 683 Atlantic Ave., Boston	iv
Blair, Isaac, & Co., Inc., 433 Harrison Ave., Boston	xiv
Boston Bridge Works, Inc., 47 Winter St., Boston	xiv
Boston Insulated Wire & Cable Co., Dorchester	xv
Bruno & Petitti, Contractors, 18 Tremont St., Boston	iv
Clifford & Roeblad, 101 Tremont St., Boston	iv
Coleman Bros., 245 State St., Boston	ix
Conant Machine Co., Concord Jct., Mass.	ix
Crandall Engineering Co., 102 Border St., East Boston	xi
Gibson, Richard, & Son, 65 Long Wharf, Boston	ix
Eastern Bridge and Structural Co., Worcester	viii
Electric Blue Print Co., 36 Bromfield St., Boston	ix
Fay, Spofford & Thorndike, 200 Devonshire St., Boston	iii
Fuller & McClintock, 170 Broadway, New York	iii
Giant Portland Cement Co., Philadelphia, Pa.	xv
Gow, Chas. R., Co., 957 Park Square Building, Boston	vi
Granite Paving Block Mnfrs' Assoc., 31 State St., Boston	xiii
Grid Flat Slab Corporation, 568 Columbia Rd., Boston	xii
Hall, John G., & Co., 114 State St., Boston	ix
Holbrook, Cabot & Rollins Corpn., 6 Beacon St., Boston	vi
Holzer, U., Inc., 333 Washington St., Boston	vii
Jackson & Moreland, Park Square Building, Boston	iii
Keating, P. J., Company, 280 Main Street, Fitchburg, Mass.	xvii
Leighton-Mitchell Co., 99 Chauncy St., Boston	xv
Main, Charles T., 200 Devonshire St., Boston	ii
Makepeace, B. L., Inc., 387 Washington St., Boston	xii
Metcalf & Eddy, 14 Beacon St., Boston	iii
Monks & Johnson, 99 Chauncy St., Boston	iv
New England Foundation Co., Inc., 120 Tremont St., Boston	ix
Old Corner Book Store, 50 Bromfield St., Boston	ix
Palmer Co., Inc., John E., 1012 Old South Building, Boston	ix
Pennsylvania Cement Co., 161 Devonshire St., Boston	viii

PAGE
Perrin, Seamans & Co., 57 Oliver St., Boston vii
Portland Stone Ware Co., 49 Federal St., Boston v
Rideout, Chandler & Joyce, 178 High St., Boston ix
Rockport Granite Co., Rockport v
Rowe Contracting Co., Centre St., West Roxbury vii
Scully Co., 118 First St., Cambridge xv
Simpson Bros. Corpn., 77 Summer St., Boston v
Smith, B. F., & Co., Merchants Bank Building, 79 Milk St., Boston . . . ix
Spaulding-Moss Co., 42 Franklin St., Boston xiv
Standard Oil Co. of New York, 31 St. James Ave., Boston xvii
Stone & Webster, Inc., 147 Milk Street, Boston xvi
Stuart, T., & Son Co., Newton, Mass. xi
The Thompson & Lichtner Co., 80 Federal St., Boston iii
Thorpe, Lewis D., 200 Devonshire St., Boston iii
Tucker, Edward A., Co., 101 Milk St., Boston iv
Waldo Brothers and Bond Co., 202 Southampton St., Boston . . . viii
Warren Foundry and Pipe Co., 201 Devonshire St., Boston vii
Weston & Sampson, 14 Beacon St., Boston iii
Whitman & Howard, 220 Devonshire St., Boston iii
Worcester, J. R., & Co., 79 Milk St., Boston iii
Wright & Potter Printing Co., 32 Derne St., Boston x

PROFESSIONAL CARDS

CHAS. T. MAIN

ENGINEER

200 Devonshire Street, Boston, Mass.
10th Floor Massachusetts Trust Building

Plans and Specifications for the erection and equipment or reorganization of textile mills and other industrial plants, including steam and water-power plants

H. S. ADAMS

Consulting Engineer

100-1 AMES BUILDING
BOSTON, MASS.

ASPINWALL & LINCOLN

Civil Engineers

46 CORNHILL

BOSTON

FAY, SPOFFORD & THORNDIKE

Consulting Engineers

Investigations Reports Designs
Engineering Supervision Valuations

Port Developments Industrial Plants
Bridges Buildings Foundations
Water and Sewerage Systems

200 DEVONSHIRE STREET, BOSTON

FULLER & McCLINTOCK

Engineers

NEW YORK, 170 Broadway

PHILADELPHIA, PA., 1001 Chestnut St.
TOLEDO, OHIO, Summit-Cherry Bldg.
KANSAS CITY, MO., 600 Walnut St.
MEMPHIS, TENN., 879 North Parkway.

H. K. BARROWS

Consulting Hydraulic Engineer

Water Power, Water Supply, Sewerage, Drainage. Investigations, Reports, Valuations, Designs, Supervision of Construction.

6 BEACON ST. BOSTON, MASS.

METCALF & EDDY

LEONARD METCALF HARRISON P. EDDY
CHARLES W. SHERMAN ALMON L. FALES
FRANK A. MARSTON J. P. WENTWORTH

CONSULTING ENGINEERS

Water Works, Sewerage Works, Industrial Wastes, Municipal Refuse, Drainage, Flood Protection, Supervision of Construction and Operation, Valuations, Laboratory for Chemical and Biological Analyses.

14 BEACON STREET BOSTON, MASS.

THE THOMPSON & LICHTNER CO.

Sanford E. Thompson William O. Lichtner

CONSULTING ENGINEERS

Design of Steel and Reinforced Concrete; Review of Plans; Estimates and Appraisals; Tests of Cement and Concrete; Organization and Management of Construction and Industrial Work.

OFFICES AND LABORATORY
80 FEDERAL STREET, BOSTON

LEWIS D. THORPE

Civil and Sanitary Engineer

Water Works, Sewerage and Sewage Disposal
Supervision of Construction and Operation

200 Devonshire Street

BOSTON, MASS.

WESTON & SAMPSON

ROBERT SPURR WESTON G. A. SAMPSON

Laboratory for the Analysis of Water, Sewage, Filtering Materials, etc., Design, Inspection and Supervision of Water Purification and Sewage Disposal Plants.

14 BEACON STREET, BOSTON, MASS.

WHITMAN & HOWARD

Civil Engineers

(Established in 1869)

220 Devonshire Street Room 504

BOSTON

J. R. Worcester E. E. Pettee G. H. Brazer
MEMBERS OF AM. SOC. C. E.

J. R. WORCESTER & CO.

Consulting and Designing Engineers

Bridges Foundations
Steel and Reinforced Concrete Construction

79 MILK STREET, BOSTON

Cement Testing Laboratory at Waltham, Mass.

Dugald C. Jackson Edward L. Moreland

JACKSON & MORELAND

Consulting Engineers

PARK SQUARE BUILDING BOSTON, MASS.

Clifford & Roeblad
Designing and Consulting
Architectural Engineers
Consulting Engineers on
Building & Structural Work
101 Tremont St., Boston Main 7228

MONKS & JOHNSON
ARCHITECTS—ENGINEERS
99 Chauncy Street
Boston

EDWARD A. TUCKER COMPANY
CONSULTING ENGINEERS
CONCRETE REINFORCEMENT
REMOVABLE METAL FORMS
101 Milk Street, Boston, Mass.

Your Professional Card
Would Look Well
IN THIS SPACE!

Your Patronage
MEANS MORE ADVERTISING—
More Advertising
MEANS A BETTER JOURNAL

JOSEPH BRUNO FRANK PETITTI ALPHONSO BRUNO

BRUNO & PETITTI
CONTRACTORS
WATERWORKS, SEWERS, HIGHWAYS AND CONCRETE CONSTRUCTION
18 Tremont Street, Boston, Mass.

NEW YORK
101 Park Avenue

BOSTON
683 Atlantic Avenue

J. W. BISHOP COMPANY
GENERAL CONTRACTORS

PROVIDENCE
617 Butler Exchange

WORCESTER
109 Foster Street

SIMPSON BROS. CORPORATION

TRADEMARK REG.
LAID BY SIMPSON BROS. CORPORATION
77 SUMMER STREET
BOSTON.

ENGINEERS AND CONTRACTORS
FOR
REINFORCED CONCRETE CONSTRUCTION

HASSAM CONCRETE STREET PAVEMENT

PORTLAND STONE WARE CO.

MANUFACTURERS OF

**SALT GLAZED SEWER PIPE, FLUE LINING,
LAND TILE, OIL FIRE BRICK,
BUILDING MATERIAL
PORTLAND CEMENT**

FACTORIES
PORTLAND, ME.
PATTON, PA.

49 FEDERAL STREET
BOSTON, MASS.

YARD
CHARLESTOWN,
MASS.

ROCKPORT GRANITE

RED GREEN GRAY

For Monumental Buildings, Bridges, Sea Walls and Paving Blocks

It is an undeniable fact that chemical changes take place in the cement of CONCRETE construction exposed for any number of years to sea water, changes that are certainly not for the better.

No changes take place in Rockport Granite. It is permanent, and it is impermeable; and these FACTS are beyond question. The same facts apply to masonry work of every description—Rockport Granite is the ONE material of PERMANENCY.

A combination of Quality and Low Price is offered in Rockport Granite, full details of which will be supplied upon request. Write.

ROCKPORT GRANITE CO. - Rockport, Mass.
C. HARRY ROGERS, Treas. and Gen'l Mgr.

Branch Offices
Boston, New York City, Chicago, Detroit, Cleveland and Philadelphia

Holbrook, Cabot & Rollins Corp'n

CONTRACTORS

Heavy Masonry and Concrete Construction
Deep Foundations

6 BEACON STREET BOSTON, MASS.

52 Vanderbilt Avenue
New York, N. Y.

J. W. ROLLINS, President
A. P. HOOVER, Vice-President
W. S. PATTEN, Treasurer

FOUNDATIONS
ENGINEERS AND CONTRACTORS

Chas. R. Gow Company
957 Park Square Building
Boston

NEW ENGLAND AGENTS
Raymond Concrete Pile Company

GOW CAISSONS
RAYMOND CONCRETE PILES
SOIL TEST BORINGS

140 CEDAR ST., NEW YORK CITY 111 W. MUNROE ST., CHICAGO

Rowe Contracting Company

GENERAL CONTRACTORS

Broken Stone, Asphalt Paving and Mastic

BOSTON QUARRY
Centre St., W. Roxbury
Tel. Parkway 2230

BOSTON 48, MASS.

MALDEN QUARRY
Salem Street
Tel. Malden 1510 & 0483

WARREN FOUNDRY and PIPE CO.

(FORMERLY WARREN FOUNDRY AND MACHINE COMPANY)
MANUFACTURERS OF

Cast Iron Gas and Water Pipe

FLANGE PIPE ***SPECIAL CASTINGS***

201 Devonshire St.,
BOSTON, MASS.

SALES OFFICES

11 Broadway,
NEW YORK

PERRIN, SEAMANS & CO.

Machinery, Tools and Supplies
FOR
Construction Work

57 OLIVER STREET, BOSTON

U. HOLZER, Inc.

BOOK-BINDER

333 Washington St., Opposite Milk St., or 24 Province St.
ESTABLISHED 1870

All kinds of Books bound and repaired.
Maps and Charts mounted.
Portfolios, Scrap Books, Blank Books, etc., made to order.
Lettering in Gold; Paper-Splitting; Inlaying; etc.
Photographs Mounted on Card or Paper without Cockling.

Main Shop
at
Hyde Park

EASTERN BRIDGE
— AND —
STRUCTURAL CO.

Worcester, Massachusetts,
For Prices on all Classes of
STEEL AND IRON WORK.

WE DESIGN AND MANUFACTURE
ROOF TRUSSES, GIRDERS, COLUMNS, STAIRS
AND FIRE ESCAPES FOR BUILDINGS . . . .

FOOT BRIDGES, HIGHWAY BRIDGES, RAILROAD BRIDGES

We Carry a Large Stock of
I-BEAMS, PLATES AND ANGLES

Can Make Quick Deliveries. Send in Your Inquiries.

THE EXTREME HIGH QUALITY OF
PENNSYLVANIA PORTLAND CEMENT
MAKES ITS USE ESSENTIAL WHERE
WORK OF THE HIGHEST CLASS IS DESIRED

PENNSYLVANIA CEMENT CO.

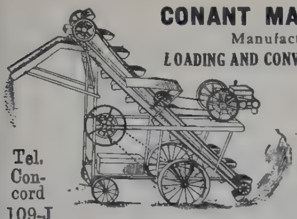
NEW YORK OFFICE
131 East 46th St.

BOSTON OFFICE
161 Devonshire St.

WALDO BROS. AND BOND COMPANY

Building Material and
Construction Equipment

202 SOUTHAMPTON STREET, BOSTON, MASS.



CONANT MACHINE CO.
Manufacturers of
LOADING AND CONVEYING MACHINERY

SPROCKETS
CHAINS
BUCKETS

Tel.
Concord
109-J

CONANT GRAVEL LOADER

Concord Jct.,
Mass.

PORTER W. DORR
MANAGER

TELEPHONE
MAIN 0283

THE ELECTRIC BLUE PRINT CO.
36 BROMFIELD STREET
BOSTON, MASS.

BLUE, BLACK AND
VANDYKE PRINTING
ON PAPER OR LINEN

PHOTOSTAT
PRINTS

JOHN G. HALL & CO.
114 STATE STREET, BOSTON

=PILING=

A SPACE THIS SIZE COSTS
ONLY $10.00 FOR A YEAR
(TEN ISSUES).

RIDEOUT, CHANDLER & JOYCE
Engineers and Piping Contractors
178 HIGH STREET - BOSTON, MASS.

Steam Specialties, Engineers' Supplies
Piping of All Kinds Furnished or Erected

ROY H. BEATTIE
Harbor Improvements
Divers :: Lighters
209 BEDFORD STREET
FALL RIVER, MASS.

SCIENTIFIC BOOKS
AND PERIODICALS

THE OLD CORNER BOOK STORE
50 Bromfield Street
BOSTON, MASS.

JAMES R. GIBSON

RICHARD GIBSON & SON
BUILDING CONTRACTORS

MEMBERS
MASTER BUILDERS' ASSOCIATION,
BOSTON, MASS.

OFFICE: 65 LONG WHARF, BOSTON
TEL: MAIN 3701

JOHN E. PALMER CO., INC.
JOHN E. PALMER
DANIEL S. BELL JOHN A. STARR

CONTRACTING ENGINEERS
Contractors for Sewers, Water Works,
Concrete Construction, Foundations,
Roads, Landscape Work, Etc.

1012 OLD SOUTH BUILDING
294 WASHINGTON ST., BOSTON, MASS.

B. F. SMITH & CO., INC.
ESTABLISHED 1878
Engineers and Contractors
ARTESIAN AND DRIVEN WELLS
FOUNDATION BORINGS
79 MILK STREET
BOSTON, MASS.

New England Foundation Co., Inc.
Engineering and Construction
Simplex Concrete Piles
Caissons — Difficult Foundations
120 TREMONT STREET BOSTON, MASS.

COLEMAN BROS., Inc.
JOHN F. COLEMAN, Pres. and Treas.
General Contractors and Builders
Main Office
245 STATE STREET, BOSTON
Brewer Building CONGRESS 6886

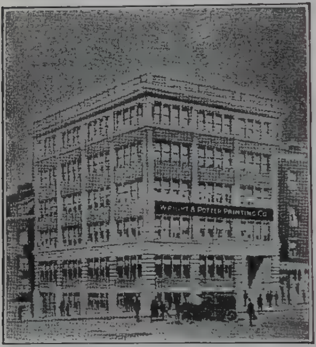
Associated Architects Printing & Supply Co.

NEW LOCATION BETTER AND LARGER QUARTERS

25 Pearl Street, Boston

BLUE, BLACK AND VANDYKE PRINTS
GELITHO REPRODUCTIONS
SUPPLIES

Telephones, Main 8482 and 8483, Connecting All Departments



WRIGHT & POTTER PRINTING COMPANY

COMMERCIAL PRINTERS

32 Derne Street, - - Boston, Mass.

THIS entire building devoted to all kinds of Book, Job and Catalog Printing and Binding

Tel. Haymarket 2000-2001-2002

Bay State Dredging & Contracting Co.

THE ASSOCIATED GENERAL CONTRACTORS OF AMERICA
AGC

CONTRACTORS

River and Harbor Improvements, Sea Walls, Breakwaters, Heavy Masonry Construction.

62 Condor Street, East Boston, Mass.

JAMES E. CASHMAN, Treas.
GORHAM H. WHITNEY, Prest. DAVID J. WHITE, Gen. Mgr.

T. Stuart & Son Company

General Contractors

NEWTON, MASSACHUSETTS

THE CRANDALL ENGINEERING COMPANY

CONSULTING AND
CONSTRUCTING ENGINEERS

DESIGN of Floating, Basin, and Railway Dry Docks, Wharves, Piers, Bridges, etc.

CONSTRUCTION of these and other Engineering Structures

102 BORDER STREET
EAST BOSTON, MASS.

Supplies for Engineers

"from stake tack to transit"
"from thumb tack to blue print"

A complete line of field and office equipment and supplies

We make a specialty of repairing Surveying Instruments

Send for Catalogue

B. L. MAKEPEACE Inc.
387 WASHINGTON ST.
394 BOYLSTON ST.
BOSTON, MASSACHUSETTS

THE GRID SYSTEM SAVES

STEEL, CONCRETE AND TIME

GRID FLAT SLAB CORPORATION
568 COLUMBIA ROAD
BOSTON 25, MASS.

WHEN YOU DECIDE ON

GRANITE

FOR

CURBING OR PAVING

YOU SETTLE THE PROBLEM

FOREVER

GRANITE PAVING BLOCK MANUFACTURERS'
ASSOCIATION OF THE U. S., INC,

31 STATE STREET, BOSTON

Drafting Room Supplies

Complete Equipments
for
Architects, Engineers and Contractors

DRAWING TABLES DRAWING INSTRUMENTS
DRAFTING PAPERS INKS AND COLORS
TRACING PAPER TRACING CLOTH

Manufacturing Blue Printers
Blue Print Papers and Cloths

Prompt service on Photostat Prints and Blue Prints

Consult us on your Photostat reproductions

SPAULDING-MOSS CO.

42 Franklin St. **Boston, Mass.**

THE BOSTON BRIDGE WORKS, INC.

ESTABLISHED 1876

47 WINTER STREET *BOSTON, MASS.*

STEEL BUILDINGS AND BRIDGES

GEO. A. BLAIR L. L. STREET W. O. WELLINGTON

ISAAC BLAIR & CO., Inc., General Contractors

Shoring and Moving Buildings a Specialty

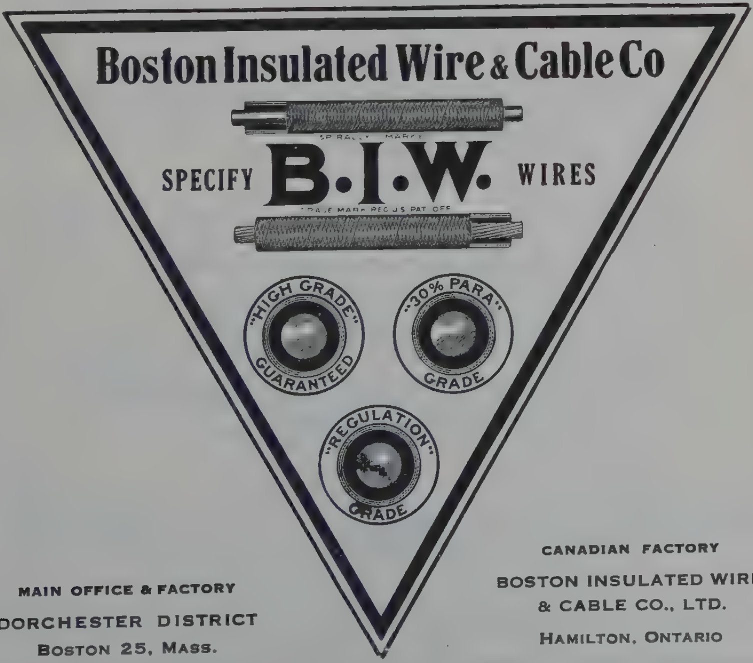
433 Harrison Avenue, BOSTON

LEIGHTON-MITCHELL Co.
BUILDERS
99 CHAUNCY STREET
BOSTON
TEL. BEACH { 7770 / 7771

GIANT
PORTLAND CEMENT
A Standard Brand since 1883
RELIABILITY - - UNIFORMITY - - SERVICE
GIANT PORTLAND CEMENT CO
PHILADELPHIA NEW YORK BOSTON NORFOLK
"CONCRETE FOR PERMANENCE"

A BUSINESS CARD in this Journal shows your interest in the Society and your appreciation of the patronage of its members

THE SCULLY COMPANY
Industrial Construction
Sand and Gravel
118 FIRST STREET CAMBRIDGE, MASS.



Boston Insulated Wire & Cable Co
SPECIFY **B.I.W.** WIRES

MAIN OFFICE & FACTORY
DORCHESTER DISTRICT
BOSTON 25, MASS.

CANADIAN FACTORY
BOSTON INSULATED WIRE & CABLE CO., LTD.
HAMILTON, ONTARIO

STONE & WEBSTER
Incorporated

DESIGN steam power stations, hydro-electric developments, transmission lines, city and interurban railways, gas and chemical plants, industrial plants, warehouses and buildings.

CONSTRUCT either from their own designs or from designs of other engineers or architects.

MANAGE public utility and industrial companies.

REPORT on going concerns, proposed extensions and new projects.

FINANCE industrial and public utility properties and conduct an investment banking business.

NEW YORK BOSTON CHICAGO

STANDARD REFINED MEXICAN ASPHALTS

(SOCONY Brands)

Furnished of required penetration and specifications for construction of Asphalt Macadam and Asphalt Concrete Roads, and for Sheet Asphalt, Asphalt Joint Filler and Bridge Asphalt.

Standard Macadam Asphalt Binder for penetration applied by SOCONY Asphalt Sprayers under pressure, at suitable temperature

QUOTATIONS AND SPECIFICATIONS FURNISHED ON REQUEST

STANDARD OIL CO. OF NEW YORK

NEW ENGLAND DEPARTMENT

Park Sq. Building, 31 St. James Ave., Boston, Mass.

P. J. KEATING COMPANY

General Contractors

Water Works, Sewers, Highways, Heavy Masonry and Concrete Construction

280 MAIN STREET FITCHBURG, MASS.

CONTRACTORS

Why not place a card in the JOURNAL?

For advertising rates apply to the Editor
715 TREMONT TEMPLE,
BOSTON, MASS.

COMMITTEES

NOMINATING COMMITTEE

Past Presidents (Members of the Committee)

Leonard Metcalf
Frank A. Barbour
Robert S. Weston

David A. Ambrose
Charles R. Berry
Frank A. McInnes
(Term expires March, 1926.)

John C. Moses
Eugene E. Pettee
Edward Wright
(Term expires March, 1927.)

SPECIAL COMMITTEES

Publication

Edward H. Cameron, *Chairman*

Francis H. Kingsbury
Frank A. McInnes
Ralph E. Rice
George A. Sampson

Program

Richard K. Hale, *Chairman, ex officio*

Henry S. Adams
John B. Babcock, 3d
Walter W. Clifford
Carl S. Drake
Harry A. Hageman
S. Stanley Kent
Edward B. Richardson
Clinton D. Thurber
Howard M. Turner
John F. Vaughan

Library

John B. Babcock, 3d, *Chairman*

G. Gale Dixon
Howard A. Gray
Everett N. Hutchins
Francis J. Mulvihill

Social Activities

George C. Houser, *Chairman*

Edward S. Averell
Donald V. C. Birrell
Henry Brask
Oliver B. Brown
Hugh D. Chase
Vernald W. Fox
Henry F. Hill, Jr.
Harold W. Kelly
Edward R. McCarthy
Benjamin E. Sullivan

Legislative Matters

Richard A. Hale, *Chairman*

John N. Ferguson
Frank O. Whitney

Welfare

John E. L. Monaghan, *Chairman*

Robert B. Farwell
Frank L. Flood
Erwin Harsch
Lewis E. Moore

Subsoils of Boston

Harry E. Sawtell, *Chairman*

Henry S. Adams
Heywood S. French
Charles D. Kirkpatrick
Albert C. Titcomb

For further information, or for contract forms, address

JOHN B. BABCOCK, 3d, Editor
715 Tremont Temple, Boston

LIBRARY AND MEETING PRIVILEGES ARE EXCHANGED WITH THE FOLLOWING ORGANIZATIONS:

American Institute of Electrical Engineers, 33 West 39th Street, New York.

American Institute of Mining and Metallurgical Engineers, 29 West 39th Street, New York.

American Society of Civil Engineers, 33 West 39th Street, New York.

American Society of Mechanical Engineers, 29 West 39th Street, New York.

Brooklyn Engineers' Club, 117 Remsen Street, Brooklyn, N. Y.

Cleveland Engineering Society, Hotel Winton, Cleveland, Ohio.

Detroit Engineering Society, Detroit Board of Commerce Building, Detroit, Mich.

Engineering Association of Nashville, Chamber of Commerce Building, Nashville, Tenn.

Engineering Institute of Canada, 176 Mansfield Street, Montreal, Canada.

Engineers' Club of Baltimore, So. East cor. Light and Redwood Streets, Baltimore, Md.

Engineers' Club of Dayton, cor. Monument Avenue and Jefferson Street, Dayton, Ohio.

Engineers' Club of Kansas City, Room 509, K. C. S. Building, Kansas City, Mo.

Engineers' Club of Philadelphia, 1317 Spruce Street, Philadelphia, Pa.

Engineers' Club of St. Louis, 3817 Olive Street, St. Louis, Mo.

Engineers' Club of Toronto, 96 King Street, West Toronto, Canada.

Engineers' Society of Pennsylvania, 31 South Front Street, Harrisburg, Pa.

Engineers' Society of Western Pennsylvania, William Penn Hotel, Pittsburgh, Pa.

Louisiana Engineering Society, State Museum Building, Jackson Square, New Orleans, La.

Montana Society of Engineers, Butte, Mont.

Pacific Northwest Society of Engineers, 803 Central Building, Seattle, Washington.

Rochester Engineering Society, 131–135 Sibley Building, Rochester, N. Y.

Technology Club of Syracuse, Vinney Building, Syracuse, N. Y.

Vermont Society of Engineers, Montpelier, Vt.

Western Society of Engineers, 1735 Monadnock Block, Chicago, Ill.

THESE COURTESIES DO NOT INCLUDE CLUBHOUSE PRIVILEGES